NUCLEAR SCIENCE ABSTRACTS

Volume 32 Number 10

Abstracts 24122-25495

November 30, 1975

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Volume 32, Number 10, November 30, 1975

NUCLEAR SCIENCE ABSTRACTS

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Published by the ERDA Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

```
HOLLOWAY, J.A., Survey of image
    processing methods for
    radiography, 31:16451
HOLLWEG, J.V., Hydromagnetic waves in
    interplanetary space, 31:17953
HOLMBERG, E.B., Distribution of
    clusters of galaxies as related to
    galactic absorption, 31:16040
HOLMES, J.J., See BATES, J.F., 31:17444
```

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

```
NUCLEAR POWER PLANTS/REACTOR LICENSING
  Experience acquired in the design and construction of
    operating plants (German Federal Republic), 31:19104
NUCLEAR POWER PLANTS/REACTOR SAFETY
  Conception of radiation safety in atomic electric power
    plants, 31:19032 (CONF-701074-P1)
NUCLEAR POWER PLANTS/SITE SELECTION
  Safety-related site parameters for nuclear power plants,
    31:19052 (WASH-1361)
  Status and development of nuclear power in the Federal
    Republic of Germany, 31:19105
NUCLEAR PROPERTIES/RESEARCH PROGRAMS
  Accelerator physics group progress report, July--December
    1973 (Research summaries), 31:18544 (INS-R-139)
```

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

17606 (ANL/HEP-7440, pp I.1-I.12) ACCELERATED POLARIZED PROTONS AT THE ZGS. Ratner, L. G. (Argonne National Lab., IL). Feb 1974.
From symposium on high energy physics with polarized beams; Argonne, Illinois, USA (8 Feb 1974).
In symposium on high-energy physics with polarized beams.

is indexed as:

```
ARGONNE NATIONAL LAB., ILL. (USA)
  Accelerated polarized protons at the ZGS, 31:17606
    (ANL/HEP-7440)
  Acceleration of polarized protons in synchrotrons,
    31:17692 (ANL/HEP-7440)
  Analysis of population, birth, and death statistics in
    the counties surrounding the Big Rock Point Nuclear
    Power Station, Charlevoix County, Michigan, 31:16552
    (ANL-8149)
  Argonne polarized target facilities, 31:17762 (ANL/HEP-
    7440)
  Calculation of transient fission-gas release from oxide
    fuels, 31:19031 (ANL-8143)
```

Report Numbers

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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WASH-
  1164            31:19025  Dep. NTIS, $16.00
  1359            31:16524  Dep. NTIS, $10.60
  1361            31:19052  Dep. NTIS, $3.75

WCAP-           (Misc.)
  7906            31:19053  Dep. NTIS, $5.50

XDC-
  50-3-68         31:18403  Dep. NTIS, $7.25

XN-             (Non-ERDA)
  74-21(Rev.1)    31:19054
  409(Suppl.4)    31:18750  Exxon, Richland, WA
  (Rev.1)

Y-
  1966            31:19188  Dep. NTIS, $4.00
```

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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The Administrator of the Energy Research and Development Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1978.

Volume 32, Number 10 November 30, 1975

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

24122 (IA-1308) RESEARCH LABORATORIES ANNUAL REPORT, 1973 AND 1974. (Israel Atomic Energy Commission, Tel Aviv). Feb 1975. 238p. Dep. NTIS (US Sales Only) $15.00.

This report presents brief summaries of the research carried out at the Israel A.E.C. laboratories during the two years 1973 and 1974. (64 figures, 29 tables) (auth)

Analytical and Separations Chemistry

Activation and Nuclear Reaction Procedures

Refer also to abstracts 24423 and 25079.

24123 (AEC-tr-7314, pp 98-105) SOME RULES PERTAINING TO THE NEUTRON ACTIVATION ANALYSIS OF MATERIAL COMPOSITION ON A TRANSPORTER. Ivanov, I. N.; Markun, N. Yu.; Kazanchenkov, Yu. N.; Filippov, V. V.; Shtan, A. S. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In Radiation technology.

The following factors affecting the value of the induced activity and the intensity of the registered gamma radiation in neutron activation analysis were studied: the displacement velocity of the material; its density; the geometrical dimensions of the layer; and the non-uniformity of distribution of the determined element in the bulk of material. (LK)

24124 (AEC-tr-7314, pp 106-110) SENSITIVITY OF ACTIVATION ANALYSIS USING A NEUTRON REACTION WITH NEUTRON ENERGY OF 14 MeV. Shtan, A. S.; Nikolaenko, O. K.; Galstyan, I. N.; Sidorov, A. V.; Filippov, V. V. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In Radiation technology.

The sensitivity of the determination of the more widespread elements by the activation method with 14-MeV neutrons at the optimum time dependent work scheme is considered. The sensitivity, expressed as pulses per unit weight of the determined element, was brought to one and the same flux (5×10^8 n/cm^2 sec) and to the fulltime of measurement, equal to 20 min, independently of the half-life period of the radioactive isotope formed by activation. (LK)

24125 (AEC-tr-7314, pp 111-113) THRESHOLD SENSITIVITY OF NEUTRON ACTIVATION ANALYSIS OF FLOW SOLUTIONS. Kartashev, E. R.; Shtan, A. S. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Activation analysis of flow solutions can be used for the determination of elements having large activation cross sections and forming short-lived isotopes on activation. The possibility of a fast determination of elements by the neutron activation method can be roughly evaluated by the so-called rapidity factor. For a more accurate evaluation of the application scope of the neutron activation method of analysis in a current of solution, a calculation of the threshold sensitivity was carried out for different elements. This calculation was based on the data of specific activation cross sections and the optimum conditions for carrying out the analysis. (LK)

24126 (AEC-tr-7314, pp 124-130) INCREASE IN THE DETERMINATION SELECTIVITY OF IRIDIUM AND GOLD BY THE NEUTRON-RESONANCE ACTIVATION ANALYSIS METHOD. Ganbaryan, R. G.; Gurkov, V. A.; Shtan, A. S. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Cadmium filters are used to raise the relative activity of elements having high resonance cross sections of neutron absorption. Systematic errors related to the presence of interfering elements generally have two origins. The attenuation of the neutron flux falling on the specimen due to neutron absorption in the specimen matrix leads to a decrease in the activity of the determined element. In gamma spectrometry of the irradiated specimen, there is a contribution in the region of the analytical photopeak from the direct and scattered gamma radiation of the corresponding elements. These errors can be excluded or reduced to a considerable degree by screening the irradiated specimens with resonance filters. This method was tested on excluding the effect of sodium in the determination of gold and of copper in the determination of iridium. (LK)

24127 (KFK-2160) MULTIELEMENT ANALYSIS OF MANGANESE NODULES BY MEANS OF NEUTRON INDUCED CAPTURE GAMMA SPECTROSCOPY. Wuerz, H ; Eberle, H. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Jun 1975. 61p. (In German). Dep. NTIS (US Sales Only) $6.25.

The investigations described were aimed toward demonstrating the sensitivity of the capture gamma method in the in-situ analysis of manganese nodules and showing the influence of variable measuring conditions on the results of the (n,γ) analysis and the way of correction. Additionally a simple concept had to be developed for determining concentrations of γ-active elements from measured line intensities. Calibration experiments were performed using homogeneous solutions of known chemical composition. The results of these experiments are applicable to the heterogeneous manganese nodule-saltwater system. This was demonstrated using 6 different probes. The results of the (n,γ) analysis could be interpreted to indicate a correlation between the Ni content and the Mn to Fe relation with an uncertainity of +25% in the Ni concentraction. (auth)

24128 (UCRL-51855) TRACE ELEMENT ANALYSIS AT THE LIVERMORE POOL-TYPE REACTOR USING NEUTRON ACTIVATION TECHNIQUES. Ragaini, R. C.; Ralston, R.; Garvis, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jun 1975. Contract W-7405-Eng-48. 32p. Dep. NTIS $4.00.

The capabilities of trace element analysis at the Livermore Pool-Type Reactor (LPTR) using instrumental neutron activation analysis (INAA) are discussed. A description is given of the technology and the methods employed, including sample preparation, irradiation, and analysis. Applications of the INAA technique in past and current projects are described. A computer program, GAMANAL, has been used for nuclide identification and quantification. (JGB)

24129 GENERALIZED CRITERION OF CHOICE OF THE OPTIMAL TIME REGIME FOR CARRYING OUT ACTIVATION ANALYSIS. Gordadze, G. P. Soobshch. Akad. Nauk Gruz. SSR; 78: No. 3, 581-584(Jun 1975). (In Russian).

The currently used criteria of choice of the optimal time regime for carrying out activational analysis are discussed. A generalized criterion based on the condition of the minimum relative error of the estimation of the concentration of the element under study written in general form is given. It is shown that with various assumptions criteria known earlier follow from the proposed criterion. Substantiated limits of the applicability of the criteria are given. (auth)

24130 USE OF NEUTRON ACTIVATION RADIOGRAPHY TO DETERMINE NEUTRON FLUX DISTRIBUTION. Navalikhin, L. V.; Flitsiyan, E. S.; Kryzhenkova, N. A.; Kist, A. A. Sov. At. Energy (Engl. Transl.); 37: No. 5, 1199-1201(Nov 1974).

Translated from At. Energ. (USSR); 37: No. 5, 434-435(Nov 1974).

The effects of inhomogeneity of the flux on the accuracy of results of neutron activation analysis for direct calibration in its various modifications were studied. The special case of identical linear dimensions of source and sample to be irradiated shows that calibration involving joint irradiation leads to considerable error. Neutron autoradiographic studies were made in attempts to reduce errors. (MCG)

24131 NEUTRON-ACTIVATION ANALYSIS OF MINERAL COMPOSITION OF BONES. Kalashnikov, V. M.; Zaichik, V. E.; Proshin, V. V. (Scientific-Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 20: No. 7, 82-86(Jul 1975). (In Russian).

The authors developed the methods of the express neutron-activation analysis of the content of Na, Mg, P, Cl, and Ca in the tissues of the bone with the use of the reactor neutrons and a semiconductor detector. The perspectives of determining Cl in the pathological tissues of the bone with a diagnostical purpose were pointed to. (auth)

24132 OPTIMIZATION OF A RUTHERFORD BACKSCATTERING GEOMETRY FOR ENHANCED DEPTH RESOLUTION. Williams, J. S. (Salford Univ. (UK)). Nucl. Instrum. Methods; 126: No. 2, 205-215(1 Jun 1975).

A simple geometrical method for improving the depth resolution of the RBS technique is presented. A critical appraisal of the resolution-limiting factors such as beam collimation, detector acceptance angle, multiple scattering, and surface topography effects is given in an attempt to optimize the geometry for maximum attainable depth resolution. An optimized low-angle geometry in which the incident beam impinges onto the target surface at 5° and the detector is positioned for 168° scattering leads to ~8 times resolution improvement; the expected system depth resolution becomes 20-30 Å for a solid-state detector (15 keV fwhm). The effects of multiple scattering and surface topography on system resolution are examined experimentally; for carefully prepared target surfaces (vibratory polished and etched) system resolutions approaching those expected from the optimum RBS geometry can be attained in practice for near-surface analysis. At large analysis depths and for samples with ill-prepared surfaces the system resolution is noticeably degraded and the resolution profile may become decidedly asymmetric. (auth)

24133 LARGE-DEPTH CONCENTRATION-PROFILE DETERMINATION USING γ RAYS PROTON-INDUCED REACTIONS. Development of a "Global" Method. Thomas, J. P.; Grea, J. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Nucl. Instrum. Methods; 126: No. 2, 303-308(1 Jun 1975).

Concentration-profile determination can be performed over a large depth range (some tenths of micrometers), especially using prompt gamma rays induced by proton reactions. Resolving a triangular equation system, the validity of which is being discussed, numerical values are obtained. Such a method, termed "global", is described here, with special emphasis on physical validity and measures of condition of the system. Experimentally, correction factors have to be introduced, like those calculated for the application proposed here concerning fluorine determination in dental enamel. (auth)

24134 NONDESTRUCTIVE FUEL ASSAY OF LASER TARGETS. II. Photonuclear [D(gamma,n)] METHOD. Caldwell, J. T.; Atwater, H. F.; Farnum, E. H.; Fries, R. J.; Hyder, A. K. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 126: No. 2, 293-297(1 Jun 1975).

A non-destructive photonuclear technique has been developed to assay the deuterium content of laser-fusion-project targets, such as a gas-filled D_2 and DT micro-balloons, and solid CD_2 LiD, or LiDT microspheres. Individual targets are irradiated by 2.754-MeV gamma rays from thermal-neutron activated ^{24}Na. Gamma-flux uniformity and maximization at the target position are achieved by inserting the target into the center of a specially designed 0.6-cm-OD$_s$, Na_2CO_3 spherical source, after the ^{24}Na has been activated in a reactor to a level of about 15 Ci/g. The spherical source in its aluminum container is inserted in the center of a tungsten or lead gamma shield, which is surrounded by a region of polyethylene. Neutrons of 0.26 MeV energy are produced in the deuterium by the D(gamma,n) reaction. These neutrons are moderated in the polyethylene and counted by ^3He or $^{10}BF_3$ detectors located in the polyethylene region. An assay sensitivity of less than or equal to 10^{-7} g deuterium with essential linearity of response over at least a mass range of 10^{-7} to 10^{-5} g deuterium has been demonstrated. (auth)

24135 NEUTRON-ACTIVATION ANALYSIS OF $LaAlO_3CaTiO_3$ MATRIX. Ryzhov, B. I.; Abdullaev, Ya. S.; Saidmuradov, T.; Khatamov, Sh. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 48-50(1975). (In Russian).

A method was developed and experimentally verified for neutron activation analysis of a matrix of $LaAlO_3CaTiO_3$. The economics of the method are shown for industrial conditions, and the possibility of using low-energy neutron sources for the analysis is discussed. (tr-auth)

24136 NEUTRON ACTIVATION ANALYSIS OF AIRBORNE PARTICULATES IN TAIWAN. II. Chou, C. C. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan); Pung, T. C.; Tsai, H. T.; Wu, S. C.; Lo, M. C.; Wei, V. H.; Hsu, T. M.; Tsein, J. C.; Yang, C. F. Nucl. Sci. J. (Taiwan); 12: No. 2, 103-108(Jun 1975). (In Chinese).

Neutron activation analysis was applied to the analysis of airborne particulates in the Taipei area. Airborne particulate samples were successfully collected by High Volume Air Sampler for 30 days. The samples were irradiated for 2 hr or 5 days in the Taiwan Research Reactor; the neutron flux was 1.8×10^{13} neutrons cm^{-2} sec^{-1}. Both chemical separation and the non-destructive methods have been applied to the irradiated samples, the gamma ray spectra were measured with a lithium-drifted germanium detector, and 13 consistent elements, (Sc, Cr, Fe, Co, Zn, As, Ag, Cd, Sb, La, Eu, Hg and Au) were determined. (auth)

Chemical and Spectral Procedures

24137 DETERMINATION OF IMPURITIES IN ALUMINUM ISOPROPYLATE. Zakharova, T. I.; Krasnikova, G. V.; Popova, G. D.; Solomatin, V. S.; Kuzovlev, I. A. Ind. Lab.; 41: No. 2, 221-222(Feb 1975).

Translated from Zavod. Lab.; 41: No. 2, 181(Feb 1975).

In the spectroscopic analysis of aluminum isopropylate, the compound was first transformed into the oxide by dissolving it in HNO_3 and heating the dried residue. An analysis of the kinetics of the volatilization of the impurities in the arc plasma showed that the optimum conditions were a 10-sec exposure time, sample weight of 10 g, and electrodes with an aperture. The wave lengths of the analytical lines and the detection limits were tabulated for In, Tl, Au, Co, Te, Bi, Sn, Pb, Cr, Ni, Cu, Be, Ag, Ti, Sb, Fe, Mg, B, Zn, and Ca. (JSR)

24138 EFFECT OF THE SAMPLE COMPOSITION ON THE RESULTS OF THE SPECTROGRAPHIC ANALYSIS OF CERIUM. Buryak, Z. I.; Novak, V. P.; Mal'tsev, V. F.; Kobus, L. F. (All-Union Scientific Investigation and Technological Construction Inst. for the Tube Production, Dnepropetrovsk, USSR). Ind. Lab.; 41: No. 2, 223-224(Feb 1975).

Translated from Zavod. Lab.; 41: No. 2, 182-183(Feb 1975).

The effect of the composition of steels and cast irons on the results of the spectrographic determination of Ce over the concentration ranges from 0.005 to 0.03 and 0.05 to 0.5% was investigated using arc excitation under Ar atmosphere to increase the sensitivity of the determination of Ce. The purpose was to determine the optimum conditions for the maximum increase in the intensity of the spectral lines. These conditions are an Ar atmosphere, operation with increased inductance of C = 0.01 μF and L = 0.15 mH, and the use of a graphite counterelectrode. An analytical sensitivity of 1×10^{-3}% was obtained under these conditions. (JSR)

24139 ATOMIC-ABSORPTION ASSAY OF ALKALINE EARTHS IN MIXED NIOBATES (EXCHANGE OF EXPERIENCE). Yakovleva, A. F.; Chupakhin, M. S. Ind. Lab.; 41: No. 2, 228-229 (Feb 1975).

Translated from Zavod. Lab.; 41: No. 2, 185-186(Feb 1975).

A method for the simultaneous determination of Ba and Sr in mixed niobates by atomic absorption is described. It is based on the complete dissolution of the material and atomic-absorption measurements made under such conditions that the Nb has no depressant effect. (JSR)

24140 ATOMIC-ABSORPTION METHOD OF LAYER ANALYSIS FOR EPITAXIAL GaAs STRUCTURES WITH CHROMATOGRAPHIC SEPARATION OF THE SUBSTRATE. Sverdlina, O. A.; Kuzovlev, I. A.; Solomatin, V. S.; Yurkova, V. Ya.; Kovykova, N. V.; Nishanov, D.; Shatalina, L. G. Ind. Lab.; 41: No. 2, 211-213(Feb 1975).

Translated from Zavod. Lab.; 41: No. 2, 172-175(Feb 1975).

The chromatographic separation of Ga and As from substrates of Cr and Te and the subsequent determination of Cr and Te in the GaAs layers by atomic absorption was tested with diisoamyl ether (DIAE) and β,β′-dichlorodiethyl ether (DCDEE) were studied. The study of the effects of Ga concentration on the extraction showed that DCDEE was more effective as the Ga concentration decreased; the DIAE extracts impurities. Mixtures of 75% by volume were found to be most effective for the Ga concentrations studied. The Te and Cr were eluted with HCl and determined by atomic absorption spectroscopy with detection limits of 1×10^{-3}% or Te and 5×10^{-6}% for Cr. The behavior of Ga, Te, and Cr were followed by the use of radioisotopes. (JSR)

24141 LUMINESCENT ANALYSIS OF INORGANIC MATERIALS (REVIEW). Shcherbov, D. P.; Plotnikova, R. N. Ind. Lab.; 41: No. 2, 159-192(Feb 1975).

Translated from Zavod. Lab.; 41: No. 2, 129-159(Feb 1975).

A bibliographic review consisting of more than 1300 entries published from the middle of 1966 to 1973 is presented on the literature of luminescent analysis and the problems associated with it. Techniques for the fluorimetry of elements in solution are outlined and tabulated. Other forms of luminescent analysis are cited. (JSR)

24142 CRATERING ANALYSIS FOR QUANTITATIVE DEPTH PROFILING BY ION BEAM SPUTTERING. Hoffman, D. W. (Ford Motor Co., Dearborn, Mich. (USA)). Surf. Sci.; 50: No. 1, 29-52(May 1975).

The depth profiling of composition by sputtering with a stationary ion beam of non-uniform intensity is treated analytically. Attention is devoted to the situation where the experimental signal originates simultaneously from all or most of the sloping, sputtered crater, as in ion scattering spectrometry (ISS) or secondary ion mass spectrometry (SIMS). As a result the signal itself does not relate directly to the composition at any specific depth in the specimen. Data processing formulas for various degrees of correction are presented, starting with a very simple result for the Gaussian intensity distribution. Simulated ISS outputs and processed data points are then illustrated for a number of selected composition profiles. An alternative use of the analysis to determine the radial intensity distribution in an ion beam is presented with experimental data supporting the Gaussian beam approximation as modified by the so-called clipping factor. A practical stratagem is proposed for overcoming such extraneous problems as beam intensity transients, while determining the depth profiles of the elements in specimens of several components. (auth)

24143 OXYGEN CONTENT EVALUATION IN LIQUID SODIUM WITH AN ELECTROCHEMICAL MEASURING PROBE. Jung, J. (Internationale Atomreaktorbau G,m,b,H. (INTERATOM), Bensberg; Koeln (F.R. Germany)). J. Nucl. Mater.; 56: No. 2, 213-220 (May 1975). (In German).

In order to measure continuously the oxygen content of sodium, a measuring probe was developed: it operates with the aid of $ThO_2-Y_2O_3$ solid electrolyte and a reference gas electrode. The probe consists of a solid electrolyte crucible, connected by a vacuum-tight soldered joint to a metal tube. Experiments with oxygen-saturated sodium, using reference gases with varying partial pressures of oxygen, showed that almost reversible emf's are attainable; the free standard enthalpy of formation thus determined, $\Delta G^{\circ}_{Na_2O}$, agrees well with published values. The calibration of a probe in a sodium loop revealed a linear relationship between the measured emf and the inverse cold-trap temperature, but deviations from reversible cell behavior were observed. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 24366, 24374, and 24386.

24144 (AEC-tr-7314, pp 130-136) DETERMINATION OF LOW CONCENTRATIONS OF IRON AND ZINC IN OILS. Mamikonyan, S. V.; Martishchenko, L. G. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The possibility of determining low concentrations or iron and zinc in an MS-20 oil and in decalin in a concentration range of 0.01-0.12% by the x-ray radiometric method was investigated. The use of ^{109}Cd as a source instead of ^{3}HIZr leads to the lowering of the sensitivity of the determination of iron and zinc in oils together with the raise in sensitivity of the determination. Use of the SI-6R counter instead of the SRM-5 also gives the possibility of lowering the sensitivity limit and increasing the determination sensitivity of the given elements. (LK)

24145 (LA-UR-73-859) DO'S AND DONT'S OF NONDESTRUCTIVE ASSAY MEASUREMENTS. Menlove, H. O. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-ENG-36. 20p. Dep. NTIS $4.00.

Some of the problem areas and recommended procedures in the application of nondestructive analysis (NDA) instrumentation are discussed. To limit the scope of the present guide, only radiometric NDA techniques employing neutron and gamma signatures are considered. Thus, measurement techniques which primarily make use of alpha particles, beta particles, muonic x rays, heat signatures, etc., are not included. (auth)

24146 (UCRL-75105) PLUTONIUM ISOTOPIC MEASUREMENTS BY GAMMA-RAY SPECTROSCOPY. Gunnink, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1973. 19p. (CONF-731093-). Dep. NTIS $4.00.

From proceedings on calorimetric assay of plutonium; Miamisburg, Ohio, USA (24 Oct 1973).

A method is reported for analysis of isotopic and total plutonium by detecting and analyzing gamma rays emitted by a sample. A computerized prototype-system was developed and is now being routinely used at the Savannah River Plant for the nondestructive assay of solution samples. The analyses for ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, and for ^{241}Am, when it is present, can be made in counting times as short as 10 to 15 minutes under optimum conditions. Comparison of isotopic ratio values with mass spectrometry generally shows agreement within 0.1 percent for ^{239}Pu and about 1 percent for ^{240}Pu and ^{241}Pu. Some preliminary isotopic measurements on solids are also discussed. (auth)

24147 NONDESTRUCTIVE FUEL ASSAY OF LASER TARGETS. I. X-Ray Method. Fries, R. J.; Farnum, E. H. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 126: No. 2, 285-291(1 Jun 1975).

A convenient method of nondestructively assaying the tritium content of gas-filled glass or metal laser targets is described. Calibration factors for various target types have been obtained, permitting the fast and accurate determination of ng quantities of tritium using a simple assembly of gas proportional x-ray counter tubes. (auth)

24148 NONDESTRUCTIVE FUEL ASSAY OF LASER TARGETS. III. Elastic-Scattering Method. Jarmie, N.; Lovoi, P. A.; Farnum, E. H.; Fries, R. J.; Young, F. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 126: No. 2, 299-302(1 Jun 1975).

A nondestructive method has been developed to measure the absolute content of DT gas-filled laser microballoon targets. Single targets are bombarded with 16.2-MeV protons, and recoil deuterons and tritons from the microballoon are detected. The method gives absolute weights of D_2 and T_2 with an accuracy of about 3 percent, and can be used for a variety of types of microballoons. The ultimate sensitivity of the method is estimated to be 0.1 ng. (auth)

24149 RAPID IDENTIFICATION AND RADIOASSAY OF PICOCURIE QUANTITIES OF THE ALPHA-EMITTING SERIES. Cross, P. (Medical Physics Dept., Royal Sussex County Hospital, Brighton, UK); McBeth, G. W.; Rimmington, H. P. (Brighton Polytechnic (UK)). Nucl. Instrum. Methods; 125: No. 3, 425-427 (15 Apr 1975).

A liquid-scintillation correlation technique suitable for the rapid identification of trace quantities of the alpha-emitting series is discussed. Preliminary results indicate that 400 pCi of ^{216}Po can be assayed in approximately 10 minutes counting time. (auth)

24150 QUANTITATIVE TRACE-ELEMENT ANALYSIS BY PROTON-INDUCED X-RAYS. Ishii, K.; Morita, S. (Tohoku Univ., Sendai (Japan). Dept. of Physics); Tawara, H. (Kyushu Univ., Fukuoka (Japan)); Chu, T. C.; Kaji, H.; Shiokawa, T. (Tohoku Univ., Sendai (Japan)). Nucl. Instrum. Methods; 126: No. 1, 75-80(15 May 1975).

The accuracy of quantitative analysis of trace elements by proton-induced x-rays was examined by using solutions of known concentration of lead and uranium. Trace elements in tomato juice and well water were quantitatively analyzed, referring to a calibration standard of uranium. Some of the results are compared with those obtained by usual analytical methods. As an example of impurity analyses where the atomic number of impurity is close to that of a matrix element, copper impurity in potassium ferricyanide $[K_3Fe(CN)_6]$ was studied by using the absorption edge of the Ni atom. (auth)

Separation Procedures

Refer also to abstract 24441.

24151 (JINR-P12-8943) EVALUATION OF HEAT OF ADSORPTION VALUES FROM THERMOCHROMATOGRAPHIC DATA. I. Principles. Aikhler, B.; Zvara, I. (Joint Inst. for Nuclear

Research, Dubna (USSR)). 1975. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Starting with the dynamic equation of ideal linear gas chromatography, some formulas were obtained for the case of a column with constant negative longitudinal temperature gradient. These allow the heats of adsorption to be evaluated from the results of thermochromatographic experiments with species under study. (auth)

24152 (NVO-155(Vol.1)) IN SITU LEACHING OF A NUCLEAR RUBBLIZED COPPER ORE BODY. Volume 1. Results of Feasibility Study. (Kennecott Copper Corp., Lexington, Mass. (USA). Ledgemont Lab.; California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1975. 33p. Dep. NTIS $4.75.

This study was undertaken to evaluate whether the nation's copper reserves could be increased by use of nuclear explosive technology. Copper reserves would be increased if the nuclear technique proposed here proves economically feasible for recovery of copper from these deposits. One specific approach has been proposed. This involves emplacement of nuclear explosives below the water table in a deep-lying copper deposit, detonating these explosives to rubblize the rock, and then passing oxygen and water through the rubblized zone to leach out the copper as copper sulfate. The copper sulfate is then brought to the surface where liquid ion exchange and electrowinning is used to remove the copper. (MCG)

24153 KINETICS OF EXTRACTION OF Tm^{+3} BY DIETHYLHEXYLPHOSPHORIC ACID AND DINONYLNAPHTHALENESULFONIC ACID. Kandil, A. T.; Choppin, G. R. (Florida State Univ., Tallahassee). J. Inorg. Nucl. Chem.; 37: No. 7/8, 1787-1789(Jul 1975).

The rate of extraction to Tm^{+3} from an aqueous phase of 0.1 M($NaClO_4$) ionic strength into a toluene solution containing either diethylhexylphosphoric acid or dinonylnaphthalene sulfonic acid has been studied as a function of the pH of the aqueous phase and of the extractant concentration in the organic phase. Rate equations for the two extraction systems have been obtained showing the dependence of the pH and the extractant concentration. (auth)

24154 SOLVENT EXTRACTION OF URANIUM FROM HYDROCHLORIC ACID SOLUTIONS BY SULFOXIDES AND THEIR MIXTURES. Mohanty, S. R.; Reddy, A. S. (Univ. of Utkal, Bhubaneswar, India). J. Inorg. Nucl. Chem.; 37: No. 7/8, 1791-1795(Jul 1975).

Studies have been made on the extraction of uranium from hydrochloric acid solutions by di-n-pentyl sulfoxide (DPSO), di-n-octyl sulfoxide (DOSO), diphenyl sulfoxide (DPhSO), tri-n-butyl phosphate (TBP), and by their mixtures, in various solvents, over a wide range of conditions. At a given strength of the extractant, extraction increases initially rapidly with increase in the acid concentration; at high acidities, above 8 M, the extraction either increases slowly (DOSO and TBP) or decreases (DPSO). Increase in H^+ at constant Cl^- or increase in Cl^- at a given H^+ increases the extraction, the latter being the more marked. Under otherwise identical conditions, extraction increases with increase in the extractant concentration. The species extracted would appear to be $UO_2Cl_2 \cdot 2DPSO \cdot HCl$, $UO_2Cl_2 \cdot 3DOSO$, and $UO_2Cl_2 \cdot 3TBP$. A mixture of two extractants extracts more than the sum of the extractions due to the individual components at concentrations corresponding to those of the mixture. The progressive decrease in the log extraction coefficient versus log extractant molarity slope for the first component with increase in the concentration of the second shows that the amount of the second component which substitutes the first in the extracted species increases with increase in the concentration of the second. Extraction decreases roughly with increase in the dielectric constant of the solvent and increases with increase in the concentration of the metal. The diminution in extraction with increase in temperature is small. (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstract 24151.

24155 (UCRL-51827) ESTIMATED VISCOSITY, SURFACE TENSION, AND DENSITY OF LIQUID DT FROM THE TRIPLE POINT TO 25 K. Briggs, C. K.; Hickman, R. G.; Tsugawa, R. T.; Souers, P. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 May 1975. Contract W-7405-Eng-48. 15p. Dep. NTIS $4.00.

The literature data for the saturated viscosity, liquid-vapor surface tension, and density of liquid hydrogen is reviewed for the temperature range 14-25°K. Extrapolations are made to estimate the corresponding values for DT and T_2. Solution mixing data is considered to estimate values for the solution eD_2-DT-eT_2. Estimated values at the 1:1 D-T triple point at 19.75°K are: viscosity, 550 x 10^{-7} Pa/s; surface tension, 4.23 x 10^{-3} N/m; and density, 225 kg/m^3. These derived values are used to illustrate, via simplified equations, some basic properties of liquid DT droplets, which may eventually be used as targets in laser-induced hydrogen fusion experiments. Slow creation of individual drops and the liquid jet method are considered. The combination of low liquid density with low surface tension will allow formation of hundreds of mu m-diameter droplets with little problem. The viscosity is sufficient to damp out oscillations on a millisecond time scale. (auth)

24156 KINETICS AND MECHANISMS OF THE LOSS OF WATER FROM THE CYCLOHEXANOL RADICAL ION AT TIMES FROM 50 PICOSECONDS TO 10 MICROSECONDS FOLLOWING FIELD IONIZATION. Derrick, P. J.; Holmes, J. L.; Morgan, R. P. (University Coll., London). J. Am. Chem. Soc.; 97: No. 17, 4936-4941(20 Aug 1975).

The rates of loss of water from a series of specifically deuterated cyclohexanols were measured at times as short as 50 psec following field ionization (FI) and at longer times extending to 10 mu sec. It is concluded that FI does not induce ring cleavage in the molecular ion prior to water loss. A previously unidentified 1,2 elimination is the fastest process effecting loss of water; loss of water initiated by 1,4-hydrogen transfer is a slower process. It is suggested that, following electron impact (EI) at 70 eV, the more energetic molecular ions undergo rapid ring cleavage to form acyclic isomers, which may delay for up to microseconds before decomposing to eliminate water. (auth)

24157 EFFECT OF MOLECULAR WEIGHT ON HYDROGEN--DEUTERIUM EXCHANGE IN A NONHELICAL POLYAMIDE. Snyder, W. D.; Klotz, I. M. (Northwestern Univ., Evanston, IL). J. Am. Chem. Soc.; 97: No. 17, 4999-5003(20 Aug 1975).

Hydrogen–deuterium exchange kinetics were measured for poly(isopropylacrylamides) over a molecular weight range from 100 to 200,000. A sharp drop in rate appears as soon as one goes from monomer to trimer. Thereafter a very slow progressive decrease is displayed. The local environment of the exchanging amide residue is largely (although not completely) established by the mutual interaction of as few as three residues in these polymers of random conformation. (auth)

24158 MOLECULAR MOTION IN SUPERCOOLED LIQUIDS. I. Pulsed Nuclear Magnetic Resonance of Lithium-7 in 11 M Aqueous Lithium Chloride. Sutter, E. J.; Harmon, J. F. (Idaho State Univ., Pocatello). J. Phys. Chem.; 79: No. 18, 1958-1961 (28 Aug 1975).

The temperature dependence of the spin-lattice relaxation time (T_1) has been measured with pulsed NMR for ^7Li in 11 M (18 mol percent) LiCl solution in H_2O and in D_2O. The temperature range (170 to 298°K) over which the measurements were made includes the T_1 minimum. The diffusion constants, at 293°K, of Li in H_2O, of Li in D_2O, and of the H_2O in these solutions have been measured using pulsed NMR. A model based upon spin-lattice relaxation by translational diffusion is employed as a best explanation for the relaxation behavior. From this model the temperature dependence of the mean time between diffusive jumps for H_2O is found to be tau equals 3.0 x 10^{-15} exp (3.1 x 10^3/T). A structural model of this system is discussed. (auth)

24159 SPECTRA OF SPONTANEOUS COMBINATION SCATTERING OF ANION RADICALS, DIANIONS, AND CARBANIONS OF ANTHRACENE AND ITS DEUTERATED DERIVATIVES. Aleksandrov, I. V.; Bobovich, Ya. S.; Maslov, V. G.; Sidorov, A. N. Dokl. Akad. Nauk SSSR; 221: No. 3, 567-569(21 Mar 1975). (In Russian).

In general, there was good correlation of the frequencies in the spectra of the compounds studied. In some cases, the frequencies of some oscillations decreased upon deuteration, which may be explained by the degree of participation of H atoms in these vibrations. The displacement differed for different oscillations and depended on the structure of the deuterated product. The changes sometimes observed in the relative intensities of the spectral lines of the A^- and A^{2-} anions upon deuteration are possibly due to a decrease in the capability of some oscillations to be displaced upon deuteration. (TTT)

24160 NEGATIVE KINETIC ISOTOPE EFFECT IN THE HYDROGENOLYSIS OF π-ALLYL NICKEL CHLORIDE. Parenago, O. P.; Rozmanova, L. A.; Frolov, V. M. (Inst. of Petrochemical Synthesis, Moscow). Kinet. Catal.; 15: No. 6, 1429-1430(1974).

Translated from Kinet. Katal.; 15: No. 6, 1611-1612(1975).

Kinetic curves are given for the formation of propylene by the hydrogenolysis and deuterolysis of π-allyl nickel chloride. It is evident that the replacement of hydrogen by deuterium leads to a significant increase in the reaction rate, i.e., there is a

negative kinetic isotope effect. This is easily explained within the framework of a previously proposed mechanism. (JGB)

24161 STABIL'NYE IZOTOPY V GEOKHIMII NEFTI. (Stable Isotopes in the Geochemistry of Petroleum). Eremenko, N. A. (ed.). Moscow; Nedra (1974). 200p.

This book deals with a new direction of studies in the field of petroleum geochemistry based on investigating the isotopic composition of elements. A study of the ratios of stable isotopes of the main elements (C, H, S, and N) in the composition of oils, accompanying gases, and the dispersed organic matter gives new material for solving a series of important problems in the geochemistry and genesis of petroleum. Basic problems are illuminated in the isotopic geochemistry of petroleum, natural gas, and dispersed organic matter. Data are given on the isotopic composition of elements in modern organisms, the organic matter of minerals, petroleum and petroleum fractions, natural gases, and surface and underground waters. Considerable attention is devoted to factors leading to fractionation of stable isotopes under natural and experimental conditions, and to the geological interpretation of observed regularities in the distribution of isotopes in natural materials. In this case, use is made of many studies over the years by the authors, and of literature data. (256 references) (tr-auth)

Isotope Exchange and Isotope Separation

24162 (INIS-mf-1693) INFLUENCE OF ROTATIONAL INELASTIC COLLISIONS ON DIFFUSION. Wahby, A. S. M. (Amsterdam Univ. (Netherlands)). 18 Sep 1974. 60p. INIS.

76 refs., 8 figs., 14 tables; coauthors A. J. H. Boerboom and J. Ros.

This thesis deals with the study of the effect of rotational inelastic collisions on diffusion. Relative diffusion coefficients have been determined in the temperature range from 240 till 420 K for the following gas mixtures. Isotopic hydrogen mixtures H_2-HD and H_2-D_2, and for the hydrogen-helium mixtures ^{4}He-H_2, ^{4}He-D_2 and ^{4}He-HD. From the determination of the temperature dependence of the diffusion coefficients of HD on one hand and the homonuclear hydrogen molecules H_2 and D_2 on the other in helium-hydrogen and isotopic-hydrogen mixtures, it is concluded that the loaded-sphere model is not applicable. Almost Lorentzian gas mixtures Ar-H_2, Ar-D_2, Ar-HD, Kr-H_2, Kr-D_2 and Kr-HD. Excellent agreement is obtained between the thermal diffusion factors of these almost Lorentzian mixtures derived from the temperature dependence of the diffusion coefficient and the measurements of Van de Ree et al. on the thermal diffusion factors of the same mixtures. Nitrogen oxide in the rare gases ^{4}He, Ne, Ar and Kr. Effective potential parameters for the various mixtures have been obtained from the measured temperature behavior of the diffusion coefficients. (auth)

24163 LIQUID TARGET SYSTEM FOR THE ON-LINE PRODUCTION AND MASS SEPARATION OF NOBLE GASES. Ansaldo, E. J.; Garvey, G. T.; Lind, J. M.; Loeser, F. W.; Naumann, F. A. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). Nucl. Instrum. Methods; 125: No. 3, 429-433(15 Apr 1975).

A system employing liquid as target material for use with an isotope separator on-line at a cyclotron for the study of noble-gas activities is described. (auth)

24164 NONUNIFORMITY OF OXYGEN ON THE SURFACE OF CHROMIUM OXIDE STUDIES BY MEANS OF ISOTOPE EXCHANGE. Muzykantov, V. S.; Ewald, G.; Von Lewis, G. (Inst. of Crystals, Novosibirsk, USSR). Kinet. Catal.; 15: No. 6, 1335-1339(1974).

Translated from Kinet. Katal.; 15: No. 6, 1512-1517(1974).

The kinetics of oxygen isotope exchange on the surface of chromium oxide was studied. It was established that the exchangeable oxygen of chromium oxide consists of two different species. From the redistribution of isotopic molecules as a function of time it was found that exchange on a sample annealed at a low temperature proceeds parallel on two regions, but that the exchange on samples annealed at high temperatures is followed by redistribution of the isotopes among the two species of exchangeable oxygen in the surface (spontaneous surface diffusion). (auth)

Feed Materials Processing

24165 (ORNL-TM-4903(Vol.2)) CORRELATION OF RADIOACTIVE WASTE TREATMENT COSTS AND THE ENVIRONMENTAL IMPACT OF WASTE EFFLUENTS IN THE NUCLEAR FUEL CYCLE FOR USE IN ESTABLISHING "AS LOW AS PRACTICABLE" GUIDES: APPENDIX A, Preparation of Cost Estimated for Volume 1, Milling of Uranium Ores. Ryon, A. D.; Blanco, R. E. (Oak Ridge National Lab., Tenn. (USA)). May 1975. Contract W-7405-eng-26. 255p. Dep. NTIS $7.60.

Methodology and detailed calculations used in estimating the costs for treating the radwastes at the model uranium mills are presented. (auth)

24166 POROUS, MICROSPHEROIDAL, NUCLEAR FUELS HAVING INTERNAL POROSITY. Googin, J. M.; Schmitt, C. R. (to U. S. Energy Research and Development Administration). US Patent 3,887,486. G21c3/02. 3 Jun 1975. Filed date 16 Oct 1972. 8p.

PAT-APPL-298,134.

A process is described for the preparation of microspheroidal particles comprising absorbing uranium cations from a uranyl aqueous solution onto small spherical ion exchange resin particles, drying the uranium-loaded resin, and then carbonizing the dried resin to form a porous carbon spheroid having closed porosity with an oxide or carbide or uranium uniformly dispersed within its volume. The same general technique can be used to form microspheres of the oxides or carbides of other actinide metals. (auth)

24167 METHOD OF MAKING MICROSPHEROIDAL NUCLEAR FUELS HAVING CLOSED POROSITY. Googin, J. M.; Schmitt, C. R. (to U. S. Energy Research and Development Administration). US Patent 3,880,769. C09k3/00. 29 Apr 1975. Filed Date 19 Dec 1972. 8p.

PAT-APPL-316,625.

A process is described for the preparation of microspheroidal particles comprising absorbing uranium cations from a uranyl aqueous solution onto small spherical ion exchange resin particles, drying the uranium-loaded resin, and then carbonizing the dried resin to form a porous carbon spheroid having closed porosity with an oxide or carbide of uranium uniformly dispersed within its volume. The same general technique can be used to form microspheres of the oxides or carbides of other actinide metals. (auth)

Radiation Chemistry

Refer also to abstracts 24602, 24618, 24622, and 24703–24705.

24168 (AEC-tr-7314, pp 190-196) CHOICE OF THE COOLING SYSTEM OF A RADIOCHEMICAL REACTOR. Osipov, V. B.; Stepanov, G. D. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Industrial radiochemical synthesis is carried out in reactors of cylindrical form. A cooling system is suggested which more fully satisfies the requirements of the heat scheme of the reactor operation. The system is characterized by its simplicity and does not have the disadvantages of the previous systems. It is composed of a cooling jacket and a tubular heat exchanger placed in the reactor. (LK)

24169 (AEC-tr-7314, pp 201-209) INVESTIGATIONS OF SOME METHODS FOR THE PURIFICATION OF METHYLDICHLOROSILANE FROM IMPURITIES. Osipov, V. B.; Mamin, E. B.; Kon'kov, N. G.; Drachev, D. V.; Korneeva, G. P.; Krutetskaya, O. N. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The effectiveness of some evacuation and distillation purification methods of methyldichlorosilane (MDCS) from impurities which restrain the yield of methylphenyldichlorosilane (MPDCS) during its radiochemical synthesis was investigated. Results show that the initial materials must be purified from their hydrolysis products by distillation. The purified materials must not come into contact with moisture in the air. The limiting factor affecting the yield of MPDCS is the hydrolysis of the initial MDCS. (LK)

24170 (COO-3221-37) NATURE OF OXYGEN CONTAINING RADICALS IN RADIATION CHEMISTRY AND PHOTOCHEMISTRY OF AQUEOUS SOLUTIONS. Technical Progress Report, 1 September 1972--1 May 1975. Czapski, G. (Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry). 1975. Contract E(11-1)-3221. 13p. Dep. NTIS $4.00.

Progress is reported in studies on the ESR detection of radicals using modulated light and the determination of redox potentials of free radicals by pulse radiolysis. (JGB)

24171 (COO-3286-12) STUDY OF THE RADIATION EFFECTS ON NUCLEIC ACIDS AND RELATED COMPOUNDS. Three Year Progress Report, 15 August 1972--14 August 1975. Wang, S. Y. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1975. Contract E(11-1)-3286. 39p. Dep. NTIS $5.00.

Research in this project has proceeded with the chemical objec-

tive of isolating and characterizing radiation products and with the biological objective of determining the action of reactive radiation products on and in biological systems. Study has also been made on the simulation of gamma radiation by various photochemical reaction conditions. Progress is reported in the chemical studies on the isolation and characterization of thymine glycols, isolation and characterization of glycols of 1-carbamyiimidazolidone as products of cytosine, identification of the major hydroperoxy thymine (T^6OOH), attempted synthesis of the nucleoside and nucleotide of T^6OOH, and synthesis and characterization of 5-hydroperoxy-methyluracil. Progress is reported in the biological studies on the effects of T^6OOH on nucleic acid components, on C–N glycosidic bonds, as a chemical mutagen, on the chromosomes of cells, and as a potential synergist of ionizing radiation. The photoproducts of uracil, cytosine, thymine, and thymidine that have been isolated and characterized are tabulated. (JSR)

24172 STUDY OF A PROCESS OF THE LIQUID-PHASE, RADIATION GRAFTING OF STYROL TO VISCOSE BY MEANS OF A METHOD OF MATHEMATICAL PLANNING. Staroverova, L. L.; Granovskii, Yu. V.; Kabanov, V. Ya.; Spitsyn, V. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 219: No. 6, 1423-1426(21 Dec 1974). (In Russian).

The independent variables for constructing a mathematical model of the radiation grafting of styrol to viscose were taken to be: the styrol content in solution which was varied from 10 to 50%; the methyl alcohol content in solution which was varied from 10 to 50%, the radiation temperature which was varied from 15 to 50°C, and the irradiation dose which was varied from 0.575 to 1.725 Mrad. A total of 16 experiments were run, and regression coefficients were obtained from the data for a regression equation which adequately describes the radiation modification of viscose fiber. At a given value of temperature, radiation dose, styrol content and CH_3OH content it is possible to find the percentage of grafting which is of interest (3 to 7%). (SJR)

24173 SHORT-LIVED SPECTRA OF OPTICAL ABSORPTION AND LUMINESCENCE DURING PULSE RADIOLYSIS OF SINGLE CRYSTAL Al_2O_3. Vinogradov, G. A.; Shubin, V. N. (Inst. of Electrochemistry, Moscow). Dokl. Akad. Nauk SSSR; 219: No. 6, 1397-1399(21 Dec 1974). (In Russian).

A direct result of electron excitation of single-crystal Al_2O_3 is the occurrence of short-lived absorption and luminescence in the visible part of the optical spectrum. Cooling of the sample from room temperature to 150°K leads to an increase of the initial intensity at the maximum of the absorption band. At the same time the position of the band and the half-width remain unchanged in both spectra. The total duration of luminescence (12 microseconds) noticeably exceeds the time for the decrease in absorption (3 microseconds). These facts indicate that the emission is not a result of direct recombination but includes a preliminary capture of one of the carriers at a trap (impurity or polarized) with subsequent formation of a bound exiton state characterized by a lifetime of ~15 microseconds. The method of pulse radiolysis with optical registration of the particles is very suitable for investigating nonequilibrium electron processes occurring in dielectric crystals. (SJR)

24174 MONTE CARLO STUDIES OF NONSTATIONARY POLYMERIZATION PROCESSES. I. Grafting of Styrene onto Preirradiated Cellulose Acetate. Yasukawa, T.; Sasaki, Y.; Murakami, K. (Tohoku Univ., Sendai). J. Polymer Sci., Polym. Chem. Ed.; 13: No. 1, 17-27(Jan 1975).

The molecular weight distribution (MWD) of polystyrene grafted onto 4 Mrad-preirradiated cellulose acetate at 50°C has been calculated on the basis of simulating reaction with several models. A model in which the coupling probability of graft radicals is proportional to the reciprocal of the square root of chain length and the growth rate is dispersed widely around the average value gave a MWD which agreed fairly well with observation. Several factors which affect the MWD of graft chains are also discussed on the basis of simulated reactions. (auth)

24175 NMR AND ESR STUDIES OF THE SOLID-STATE POLYMERIZATION OF VINYL MONOMERS. III. Methacrylic Acid. Chachaty, C.; Latimier, M.; Forchioni, A. (CEN de Saclay, Gif-sur-Yvette, France). J. Polymer Sci., Polym. Chem. Ed.; 13: No. 1, 189-199(Jan 1975).

The kinetics of postpolymerization of gamma-irradiated methacrylic acid at 77°K has been investigated by wide-line NMR and by ESR spectroscopy. The conversion yield was continuously measured in the temperature range of 260 to 280°K, from the narrowing of the NMR spectrum due to the progressive "amorphization" of the matrix, releasing the motion of monomer molecules. The rate of postpolymerization decays exponentially with time, independently of the recombination of free radicals. The local concentration of radicals remaining after prolonged annealing is actually the same as initially, showing that no recombination occurs in the microdomains of polymerization. The ^{13}C NMR study of the poly(methacrylic acid) formed by solid-state polymerization shows a predominant syndiotactic character, with an increasing contribution of isotactic sequences as the postpolymerization temperature is lowered. (auth)

24176 PROTON AND CARBON-13 NUCLEAR MAGNETIC RESONANCE OF POLY(ISOPROPENYL ACETATE). Matsuzaki, K.; Kawamura, T.; Saito, K. (Tokyo Univ.). J. Polymer Sci., Polym. Chem. Ed.; 13: No. 1, 253-257(Jan 1975).

Four samples of poly(isopropenyl acetate) were prepared at various temperatures using t-butyl perbenzoate, benzoyl peroxide, and gamma radiation as initiators. The tacticity of this polymer was determined from ^1H and ^{13}C NMR spectra. (LK)

24177 GLASS TRANSITION OF IRRADIATED POLY(METHYL METHACRYLATE) COMPOSITIONS INCORPORATING TRIALLYL CYANURATE. Pratt, G. J. (Univ. of Melbourne). J. Appl. Polym. Sci.; 19: No. 9, 2563-2569(Sep 1975).

A mechanical torsion pendulum was used to observe changes in viscoelastic behavior resulting from modification of polymer structure. Crosslinking, with consequent increase in glass temperature, was observed in gamma-irradiated poly(methyl methacrylate) compositions incorporating triallyl cyanurate, which confers partial protection against chain scission. (auth)

24178 RADIATION-INDUCED HOMOLYTIC AROMATIC SUBSTITUTION. IV. Effect of Metal Ions on the Hydroxylation of Nitrobenzene. Eberhardt, M. K. (Puerto Rico Nuclear Center, San Juan). J. Phys. Chem.; 79: No. 18, 1913-1916(28 Aug 1975).

The effect of chromium(VI), iron(III), iron(II), and copper(II) compounds on the radiation-induced hydroxylation of nitrobenzene has been investigated. $K_2Cr_2O_7$ in unbuffered solution and $K_3Fe(CN)_6$ in acidic (pH 1.4) solution gave a high conversion of hydroxyl radicals to nitrophenols with a close to statistical isomer distribution. The isomer distribution obtained with $K_3Fe(CN)_6$ in acidic solution did not change with concentration (5×10^{-4} to 5×10^{-2} M). On the other hand with $K_2Cr_2O_7$ the G (meta) increased with concentration (5×10^{-4} to 5×10^{-3} M) approaching a close to statistical distribution at the higher concentration. In unbuffered solution $K_3Fe(CN)_6$ produced mainly m-nitrophenol. We suggest that this is due to a selective oxidation of the m-hydroxynitrocyclohexadienyl radical, and to a selective reduction of the o- and p-hydroxynitrocyclohexadienyl radicals by $Fe(CN)_6^{4-}$. Contrary to the results with $K_2Cr_2O_7$ and $K_3Fe(CN)_6$, the Fe^{3+} salts ($FeNH_4(SO_4)_2$, $Fe(ClO_4)_3$, and $Fe(NO_3)_3$) at low concentration (5×10^{-4} M) gave almost exclusively ortho and para hydroxylation in high yield. The mechanism of these oxidations is discussed. Cu^{2+} (5×10^{-4} M) does not oxidize the intermediate hydroxycyclohexadienyl radicals. In all cases ($CuSO_4$, $CuCl_2$, $Cu(ClO_4)_2$, and $Cu(OCOCH_3)_2$) only trace amounts of nitrophenols with the para isomer dominant (G(para) approximately 0.1) were obtained. Depending on the metal ion, concentration, and pH, one may produce either m-nitrophenol (100 percent) or o- and p-nitrophenol (97.4 percent) or a statistical isomer distribution. (auth)

24179 RADIATION-INDUCED HOMOLYTIC AROMATIC SUBSTITUTION. V. Effect of Metal Ions on the Hydroxylation of Toluene. Eberhardt, M. K.; Martinez, M. I. (Puerto Rico Nuclear Center, San Juan). Contract AT(40-1)-1833. J. Phys. Chem.; 79: No. 18, 1917-1920(28 Aug 1975).

The radiation-induced hydroxylation of toluene was investigated in presence of $K_2Cr_2O_7$, $K_3Fe(CN)_6$, $K_4Fe(CN)_6$, $Fe(ClO_4)_3$, $Fe(NH_4)(SO_4)_2$, $CuSO_4$, $Cu(ClO_4)_2$, and $Cu(OCOCH_3)_2$. With $K_2Cr_2O_7$, $K_3Fe(CN)_6$, and the Cu^{2+} salts high conversions of the OH radicals to cresols were obtained. In all these cases the isomer distribution obtained at the highest concentration investigated (5×10^{-2} M) was the same (49 to 52 percent ortho, 22 to 24 percent meta, and 26 to 28 percent para). With the exception of $K_3Fe(CN)_6$ the percentage of G(m-cresol) increased with increasing concentration of metal salt. The pH had a marked effect on the formation of cresols due to the competing acid-catalyzed elimination of water from the initially formed hydroxymethylcyclohexadienyl radicals to give benzyl radicals. No reduction of the hydroxymethylcyclohexadienyl radicals by $Fe(CN)_6^{4-}$ was observed. For the rate of oxidation of the hydroxymethylcyclohexadienyl radicals the following sequence was established: $Fe(CN)_6^{3-}$ greater than Cu^{2+} greater than Fe^{3+}. (auth)

24180 ESR STUDY OF γ-IRRADIATED ISOTACTIC AND ATACTIC POLYPROPYLENE. Ooi, T. (Mitsui Toatsu Chemicals Inc., Yokahama, Japan). Polymer; 16: No. 7, 510-514 (Jul 1975).

An ESR study of γ-irradiated isotactic (i-) and atactic (a-) polypropylene (PP) was carried out. Both the 17 line (or 9 line) spectrum for i-PP and the 6 line spectrum for a-PP are at-

tributed to the tertiary carbon radical, $-CH_2-\dot{C}(CH_3)-CH_2-$. The difference in the hyperfine structure between the spectrum of i-PP and that of a-PP can be explained by different radical conformations owing to the stereoregularity. Hyperfine coupling and the radical conformation for the tertiary carbon radical in i- and a-PP were determined from the $\cos^2\theta$ rule. It is shown that the δ methylene proton as well as the β methylene proton contribute to the slight anisotropy in the stretched sample. The spectral change from 9 lines to 17 lines with elevation of temperature, observed at low temperature in i-PP, could be explained by the hindered oscillation of the β methylene proton. (auth)

24181 INFLUENCE OF IRRADIATION ON THE THERMAL DECOMPOSITION OF SOME PERCHLORATES. Bhattamisra, S. D.; Kund, D.; Mohanty, S. R. (Univ. of Utkal, Bhubaneswar, India). J. Inorg. Nucl. Chem.; 37: No. 7/8, 1829-1830(Jul 1975).

Although a considerable amount of work has been done on the thermal decomposition of chlorates and perchlorates, the influence of irradiation on the decomposition has not received much attention except in the case of ammonium perchlorate. It has been found that when irradiated chlorates and perchlorates are gently heated, the chemical damage fragments and other lattice defects generated by irradiation undergo recombination (annealing) reactions which tend to annul the effects of irradiation; heating in these experiments is done necessarily at temperatures at which there is no thermal decomposition of the substances. The present work deals with the influence of irradiation on the thermal decomposition of barium perchlorate which decomposes in the solid state and of lithium perchlorate which undergoes decomposition after fusion. (auth)

Radiochemistry and Nuclear Chemistry

Hot-Atom Chemistry

Refer also to abstracts 25078 and 25303.

24182 EVIDENCE FOR S(^{1}D) ATOM REACTIONS INVOLVING ^{34}S (n, gamma)^{35}S NUCLEAR RECOIL GENERATED SULFUR. Kremer, L. N.; Spicer, L. D. (Univ. of Utah, Salt Lake City). J. Am. Chem. Soc.; 97: No. 17, 5021-5022(20 Aug 1975).

The recoil sulfur species were generated by thermal neutron irradiation of CS_2. The effect of various gas additives on the total production of $CS^{35}S$ from nonlabeled CS_2 was determined in order to investigate the role of various forms of recoil atom excitation in driving the exchange reaction. The efficiency of the sulfur atom exchange reaction rose linearly within experimental error as the mole fraction of CS_2 increased. The most reasonable reaction mechanism said to account for the major features of the data is based on excited singlet sulfur atom exchange reactions with CS_2 in competition with quenching. (MCG)

24183 ILLUSTRATION OF REACTION MECHANISM IN POLYATOMIC SYSTEMS VIA COMPUTER MOVIES. Raff, L. M. (Los Alamos Scientific Lab., NM). J. Chem. Educ.; 51: No. 11, 712-716(Nov 1974).

The $CD_4 + T^*$ systems is suited for classroom illustration of reaction dynamics. Questions about the system can be illustrated by reducing selected many-body trajectories to a 16 mm color movie that represents the six-body motion in projected coordinates. Such a movie has been produced for this system. The production procedure used is reported, and a detailed description of the contents of the movie is given. (LK)

24184 RECOIL TRITIUM REACTIONS WITH TERT-BUTYL CHLORIDE. Yarbouch, C. M.; McNeal, C. J.; Mo, Y.; Tang, Y. N. (Texas A and M Univ., College Station). J. Inorg. Nucl. Chem.; 37: No. 7/8, 1822-1824(Jul 1975).

Recoil tritium reactions with various hydrocarbons and halocarbons have been studied extensively. Among chlorocarbons, reports of recoil tritium reactions with methyl, ethyl and isopropyl chlorides have already been published. After energetic T^*-for -H substitution, the resultant tritiated parent molecules are always left with vast amounts of excitation energy such that about half of them are capable of undergoing unimolecular decomposition reactions. In the present work, a report is presented on a study of recoil tritium reactions with tert-butyl chloride. In this case, the T^*-for -H substitution product may either be collisionally stabilized giving t-C_4H_8TCl or decompose giving isobutene-t (iso-C_4H_7T). (auth)

24185 DETERMINATION OF THE HEAT OF SOLUTION OF BERKELIUM METAL. Fuger, J. (Univ., Liege); Peterson, J. R.; Stevenson, J. N.; Noe, M.; Haire, R. G. J. Inorg. Nucl. Chem.; 37: No. 7/8, 1725-1728(Jul 1975).

Berkelium metal samples up to 0.5 mg each have been prepared and used for the first determination of its heat of solution. Five measurements yielded an average value of -576 ± 25 kJ/mole for the heat of solution to Bk^{3+}(aq) of the double hexagonal closest packed form of Bk metal in 1 M HCl at 298.15 ± 0.05°K. The error limits do not reflect the precision of the calorimetric measurements but rather the uncertainties in the purity of the Bk metal. (auth)

24186 SEPARATION OF NUCLEAR REACTION PRODUCTS IN THE GAS PHASE. III. Separation of Te and I With Oxygen. Boegl, W.; Baechmann, K.; Matschoss, V. (Technische Univ., Darmstadt, Ger.). J. Inorg. Nucl. Chem.; 37: No. 7/8, 1557-1561 (Jul 1975).

The transportation of Te- and I-nuclides (produced by a ^{252}Cf-source) out of the spontaneous fission products with O_2/N_2-mixtures in the gas phase has been investigated. The separation yields are given as a function of the oxygen concentration, the temperature of the transfer tube, the temperature of the cooling trap and the streaming velocity. The transfer properties of Tc, Ru, Te, and I using oxygen as reactive gas are compared. (auth)

Properties of Radioactive Materials

Refer also to abstracts 24266 and 24604.

24187 (JINR-P6-8740) CHEMICAL SEPARATION OF NIELSBOHRIUM AS EKATANTALUM IN THE FORM OF ANHYDROUS BROMIDE. II. Experiments with Spontaneously Fissioning Nielsbohrium Isotopes. Zvara, I.; Belov, V. Z.; Domanov, V. P.; Shalaevskii, M. R. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 19p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The behavior of nielsbohrium and niobium bromide compounds was compared using the frontal thermochromatography technique. The nielsbohrium spontaneous fission isotope was produced by bombarding an americium-243 target with neon-22 ions. The niobium-90 isotope was produced simultaneously in nuclear reaction with bromine. The adsorption zone of nielsbohrium is formed at a slightly higher temperature as compared with niobium and tantalum. Similar results were obtained by the authors in previous investigations of the properties of chlorine compounds of element 105. This agrees with the expected properties of nielsbohrium as ekatantalum. (auth)

24188 (LA-6025-MS) STATISTICAL THERMODYNAMIC PROPERTIES OF HEXAFLUORIDE MOLECULES. Jackson, D. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1975. Contract W-7405-ENG-36. 38p. Dep. NTIS $4.00.

Useful statistical thermodynamic properties of fifteen octahedral hexafluorides are presented in graphical form. These include: vibrational partition function; populations of low-lying vibrational states; densities of vibrational states; and cumulative vibrational population distributions. Values can be read directly from the graphs with an accuracy consistent with the accuracy of the experimental determinations of the vibrational fundamental frequencies, and the approximate validity of the harmonic oscillator approximation. Hexafluorides of the following elements were studied: S, Se, Te, Mo, Tc, Ru, Rh, W, Re, Os, Ir, Pt, U, Np, and Pu. (auth)

24189 (LBL-4071) STUDY OF SOME THERMODYNAMIC PROPERTIES OF 5f ELEMENTS. David, F.; Samhoun, K.; Guillaumont, R.; Nugent, L. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1975. Contract W-7405-ENG-48. 10p. (CONF-750913-10). Dep. NTIS $4.00.

From fourth international transplutonium elements symposium; Baden-Baden, F. R. Germany (13 Sep 1975).

Tabulations were recently published on the enthalpy of sublimation for the 4f and 5f metals at 298.15K, DELTA H/sub S/^{0}(M), and the standard enthalpy of formation at 298.15K, DELTA H/sub f/^{0} (M/sub aq/$^{3+}$), for the tripositive aqueous metal ions for these two series. Values in this tabulation for the latter half of the 5f series were not obtained from experimental measurements, but from theoretical consideration and empirical correlations drawn from the trends in the 4f series. In the present work new experimental data were used for the 5f series to modify the empirical correlations, and tabulate new values for DELTA H/sub f/^{0} (M/sub aq/$^{3+}$) and DELTA H/sub S/^{0}(M) for the second half of the 5f series. In addition, values for DELTA G/sub f/^{0} (M/sub aq/$^{3+}$) [DELTA G/sub f/^{0} equals -3FE^0 (M/sub aq/$^{3+}$/M) equals

DELTA H/sub f/^{0} - T DELTA S/sub f/^{0} for the reaction M + 3H/sub aq/$^+$ equals M/sub aq/$^{3+}$ + 3/2 H_2] are given for the 5f series and the oxidation-reduction properties of the 5f elements are discussed. (auth)

24190 (MLM-2230) PLUTONIUM PREDOMINANCE REGION DIAGRAMS. Silver, G. L. (Mound Lab., Miamisburg, Ohio (USA)). 29 Aug 1975. Contract E-33-1-GEN-53. 31p. Dep. NTIS $4.00.

Four plutonium predominance region diagrams, a technique for estimating the solubility of hydrous plutonium(IV) oxide, and a method for comparing valence state distributions of uranium, neptunium and plutonium are described. (auth)

24191 (UCRL-77104) SOLUTION CHEMISTRY OF ELEMENT 104. Hulet, E. K.; Nitschke, J. M.; Lougheed, R. W.; Wild, J. F.; Landrum, J. H.; Ghiorso, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Aug 1975. 9p. (CONF-750913-5). Dep. NTIS $4.00.

From 4th international transplutonium elements symposium; Baden-Baden, F.R. Germany (13 Sep 1975).

Extraction chromatography was used to study the ionic properties of element 104. (LK)

24192 ANALYTICAL QUESTIONS OF RADIOCHEMICAL PURITY CONTROL OF PROTEIN AGGREGATES LABELED WITH RADIOIODINE. Kovach, A. (Orszagos Gyogyszereszeti Intezet, Budapest). Izotoptechnika.; 18: No. 5, 228-235(May 1975). (In Hungarian).

By means of paper electrophoresis the ratios of different contaminants could be determined. (auth)

24193 RAPID SYNTHESIS OF CARRIER FREE ^{11}C-DOPAMINE HYDROCHLORIDE. Fowler, J. S.; Wolf, A. P.; MacGregor, R. R. (to U. S. Energy Research and Development Administration). US Patent Application 533,112. Filed date 16 Dec 1974. 8p.

The method of preparing carrier-free ^{11}C-dopamine.HCl comprising the steps of reacting 3,4-dibenzyloxybenzylchloride with Na^{11}CN to form 3,4-dibenzyloxyacetonitrile which is hydrogenated to form carrier-free ^{11}C-dopamine.HCl is given. (auth)

24194 URANYL COMPLEXES AS CHELATE LIGANDS TOWARD TRANSITION METAL IONS. Vidali, M.; Vigato, P. A.; Casellato, U.; Tondello, E.; Traverso, O. (CNR, Padua). J. Inorg. Nucl. Chem.; 37: No. 7/8, 1715-1719(Jul 1975).

The synthesis and the characterization (ir spectra, electronic spectra, susceptibility, conductance) of some uranyl complexes containing macrocyclic Schiff base ligands are reported. These cyclic complexes may act as ligands towards transition metal ions, and the synthesis of mixed uranyl complexes containing a transition metal ion is reported. (auth)

24195 INTERACTION OF 2,2'-BISBENZOXAZOLINE WITH URANYL ION. Cattalini, L.; Vigato, P. A.; Vidali, M.; Degetto, S.; Casellato, U. (CNR, Padua). J. Inorg. Nucl. Chem.; 37: No. 7/8, 1721-1723(Jul 1975).

The synthesis and characterization (i.r. spectra, NMR spectra) of a number of complexes of uranyl (VI) ion containing the anionic residue of bis-benzoxazoline rearranged to its Schiff base tautomeric form (H_2B) and a neutral ligand are reported and discussed together with kinetic data on the reaction between UO_2^{2+} and the organic ligand H_2B in ethanol solution at different temperatures. (auth)

24196 URANIUM(V) DIOL, PHENOXIDE, AND THIOL COMPLEXES. Bagnall, K. W. (Univ. of Manchester, Eng.); Bhandari, A. M.; Brown, D. J. Inorg. Nucl. Chem.; 37: No. 7/8, 1815-1816(Jul 1975).

The preparation of uranium (V) aromatic diolates, phenoxide and thiolates is described. Uranium pentaethoxide was prepared and was reacted with toluene-2,3- and 3,4-diols in benzene at room temperature; with phenol under reflux; or with p-thiocresol in benzene under reflux, respectively. Infrared and visible spectra were recorded. (UK)

Radioactive Waste Treatment

Refer also to abstract 24712.

24197 (HEDL-SA-963) WASTE VOLUME REDUCTION BY ACID DIGESTION. Lerch, R. E.; Divine, J. R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1975. Contract AT(45-1)-2170. 32p. (CONF-750902-8). Dep. NTIS $4.75.

From 80th national meeting of the American Institute of Chemical Engineers; Boston, Massachusetts, USA (7 Sep 1975).

Acid digestion is a process being developed at the Hanford Engineering Development Laboratory (HEDL) in Richland, Washington, to reduce the volume of alpha-contaminated combustible waste by converting it into a non-combustible residue. Typical waste materials such as polyvinylchloride (PVC), polyethylene, paper and other cellulostic materials, ion exchange resin, all types of rubber, etc., are digested in hot (230°C–270°C) concentrated sulfuric acid containing nitric acid oxidant to form inert residues generally having less than four percent of their original volume and less than twenty-five percent of their original mass. The process is currently being tested using non-radioactive waste in an Acid Digestion Test Unit (ADTU) with all glass equipment. Engineering tests to date have shown acid digestion to be a potentially attractive method for treating combustible waste materials. Based on results of the engineering tests, an acid digestion pilot unit capable of treating radioactive wastes is being designed and constructed. Design capacity of the pilot unit for radioactive waste will be 100 kg of waste per day. (auth)

24198 (ICP-1075) FLUIDIZED-BED CALCINATION OF SIMULATED HIGH-LEVEL COMMERCIAL WASTES. Interim Report. Freeby, W. A. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs – Operations Office). Jun 1975. Contract AT(10-1)-1375. 41p. Dep. NTIS $4.00.

Experimental results on the development of flowsheets for the calcination of commercial high and intermediate-level waste are reported. (auth)

24199 (ICP-1078) VOLATILE RUTHENIUM REMOVAL FROM CALCINER OFF-GAS USING SOLID SORBENTS. Newby, B. J.; Barnes, V. H. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs–Operations Office). Jul 1975. Contract E(10-1)-1375. 56p. Dep. NTIS $5.45.

Laboratory studies were made to find the most effective solid sorbent for removing volatile ruthenium from calciner off-gas. Silica gel is now used for volatile ruthenium removal in the Waste Calcining Facility (WCF) located at the Idaho Chemical Processing Plant (ICPP). Silica gel was again selected as the most effective solid sorbent for removing volatile ruthenium, and operating conditions were defined for maximizing silica gel effectiveness. (auth)

24200 (MLM-2217) TRITIUM EFFLUENT CONTROL PROJECT. Progress Report, October--December 1974. Kershner, C. J. (Mound Lab., Miamisburg, Ohio (USA). 25 Aug 1975. Contract E-33-1-GEN-53. 23p. Dep. NTIS $4.00.

Installation of the pilot-scale cryogenic adsorbate separation system in the new Tritium Effluent Control Laboratory is beyond 50 percent completion. In the hydrogen gettering study, HIP alloy was found to sorb 2.2 wt percent hydrogen at room temperature. The possibilities for tritium decontamination by molecular excitation were investigated. The best scheme for tritium removal was determined to be selective photodissociation of HTO in the presence of H_2. Three additional materials were evaluated for use in an extractive distillation system for tritiated liquid waste decontamination. A computer program was developed for calculating operating and design parameters for catalytic exchange enrichment and stripping of tritiated water. (LK)

24201 (MLM-2235) TRITIUM EFFLUENT CONTROL PROJECT. Progress Report, January--March 1975. Kershner, C. J.; Bixel, J. C. (Mound Lab., Miamisburg, Ohio (USA)). 27 Aug 1975. Contract E-33-1-GEN-53. 28p. Dep. NTIS $4.00.

The 100-cfm, pilot-scale helium purification unit was installed in the Tritium Effluent Control Laboratory. Hydrogen-HIP alloy isotherm data were obtained at 28, 200, 400, and 600°C. In order to more clearly define the frequency and power of IR radiation required for the molecular excitation scheme, a study of the HDO IR spectrum was undertaken. The continuing theoretical analysis of the H_2O/H_2 system led to three major results: (1) the isotope effects on the key reactions in the H_2O/H_2 system were calculated and will be used to model the kinetics of the scavenging process; (2) the rate of the exchange reaction, $T + H_2O$ yields $HTO + H$, was analyzed with a simple theoretical model and shown to be extremely slow relative to the exchange reaction, $T + H_2$ yields $HT + H$; and (3) the effect of tritium beta decay on the H_2O/H_2 system was calculated in a qualitative manner. (LK)

24202 (SGAE-2200) THERMOGRAVIMETRIC STUDY OF THE BEHAVIOR OF BITUMEN. I. Characterization of Pure Bitumen Types. Zeger, J.; Knotik, K.; Schopper, G. (Oesterreichische Studiengesellschaft fuer Atomenergie G. m. b. H., Seibersdorf. Inst. fuer Chemie). Dec 1973. 19p. (In German). Dep. NTIS (US Sales Only) $4.00.

Comparative studies of bitumen samples were made with respect to their softening point with temperature increase, penetrability during the slurry state, fracture point, and viscosity. The studies were made with a Mettler thermobalance. The purpose was to find a bitumen suitable for the embedding

of radioactive wastes with activities of 1 to 10 Ci/l. The most suitable bitumen tested was the type B 40. (tr-auth)

24203 (SGAE-2245) SEDIMENTATION LEACHING OF COMPLETELY LOADED BITUMEN–SALT MIXTURES. Huber, I.; Jakusch, H.; Knotik, K.; Sorantin, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf, Forschungszentrum). Feb 1974. 34p. (In German). Dep. NTIS (US Sales Only) $4.75.

The resistance of bitumen and several plastics precipitation loaded with salts to leaching by distilled water, ground water, or synthetic sea water was studied in order to determine their suitability as a material for the embedding and storage of low and medium activity radioactive wastes. For most of the tests NaCl was the salt solution used. The effects of geometry, temperature, radiation, and grain size of the precipitate on the leach rate were determined and the results are given graphically. (JSR)

24204 INDUSTRIAL TECHNIQUE. Robertson, D. H. (to U. S. Energy Research and Development Administration). US Patent 3,887,339. B01d53/14. 3 Jun 1975. Filed date 19 Nov 1973. 13p.

PAT-APPL-417,434.

Techniques for selectively extracting and storing only krypton and xenon in the waste gases that are released from a pressurized water nuclear power reactor are described. The illustrative fluorocarbon absorption system has three separation stages: an initial gas-fluorocarbon absorber, a flash chamber and fractionator for segregating all of the absorbed gases from the loaded absorber stage fluorocarbon (save for the krypton and xenon), and a stripper that receives the partially loaded fluorocarbon liquid directly from the fractionator in order to separate only the krypton and xenon. A molecular sieve filter dries the input process gas, a cartridge type solvent filter is used to remove radiation degradation products from the loaded liquid that flows from the absorber, a cold trap gas drier is provided to remove residual solvent vapor from the separated krypton and xenon, and radiation detectors automatically activate valves to establish safe conditions in the event of an accident or plant failure. (auth)

24205 NOBLE GAS ABSORPTION PROCESS. Thomas, J. W. (to U. S. Energy Research and Development Administration). US Patent 3,890,121. B01d53/02. 17 Jun 1975. Filed date 19 Feb 1974. 15p.

PAT-APPL-443,262.

A method of removing a noble gas from air comprising the use of activated carbon filters in stages in which absorption and desorption steps in succession are conducted in order to increase the capacity of the filters is described. (auth)

24206 IMPROVED PROCESS FOR CALCINING RADIOACTIVE WASTES CONTAINING SODIUM NITRATE. Newby, B. J. (to U. S. Energy Research and Development Administration). US Patent Application 544,741. Filed date 28 Jan 1975. 12p.

Particle agglomeration during fluidized bed calcination of liquid acidic radioactive wastes containing sodium nitrate is prevented by the addition of iron to the acidic liquid waste before calcining. The calcine formed is inert and can be further processed for solid waste storage. (auth)

24207 METHOD OF CONVERTING NUCLEAR-FUEL WASTES TO AN INERT SOLID. Berreth, J. R. (to U. S. Energy Research and Development Administration). US Patent Application 528,766. Filed date 2 Dec 1974. 6p.

Predominantly sodium-containing nuclear-fuel wastes (either in liquid or solid form) are converted to an inert solid material by adding a slight excess with respect to the formation of albite ($Na_2O.Al_2O_3.6SiO_2$) of alumina and silica to the wastes and sintering the mixture at 800 to 1100°C to form albite. Alumina may be added as hydrated kaolinic clay and silica as silica sand. (auth)

24208 SILICON REMOVAL FROM INCINERATOR ASH BY REACTION WITH NOF.3HF. Auge, R. G.; DeGrazio, R. P. (to U. S. Energy Research and Development Administration). US Patent 3,882,040. G21c11/42. 6 May 1975. Filed date 21 Jun 1973. 6p.

PAT-APPL-372,134.

Incinerator ash containing silicon is contacted with nitrosyl fluoride trihydrogen fluoride (NOF.3HF) converting silicon present to silicon tetrafluoride (SiF_4) gas, thereby minimizing formation of gelatinous silica polymer in subsequent treatment of the ash to recover plutonium, americium, and the like. (auth)

24209 SOLID SORBENT FOR TRAPPING IODINE. Richardson, D. M.; Bamberger, C. E. (to U. S. Energy Research and Development Administration). US Patent 3,880,619. B01d53/00. 29 Apr 1975. Filed Date 5 Sep 1974. 6p.

PAT-APPL-503,238.

Lead monoxide is used as a sorbent for iodine. (auth)

Radioisotope Production

Refer also to abstract 24445.

24210 (JU-RR–74/7) RAPID ON-LINE SEPARATION SYSTEM BY USING HELIUM-JET AND CENTRIFUGAL TECHNIQUES. Hellmuth, K. H.; Valli, K. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Nov 1974. 24p. (In German). Dep. NTIS (US Sales Only) $4.25.

A centrifuge for continuous liquid-liquid phase separation is described. It is designed for rapid solvent extraction of short-lived radioactive isotopes (half-lives in the order of seconds). The centrifuge is characterized by simple construction and operation principle, easy handling, low cost, and a minimum hold-up time of less than five seconds (phase purity 99.0 to 99.9%). The on-line connection to a helium-jet transport system is described. Problems concerning the transfer of activities into a liquid phase from the helium-jet at atmospheric pressure are discussed. (auth)

24211 ELECTROLYSIS OF RADIOACTIVE SUBSTANCES AT A MERCURY CATHODE. Madi, I. (Kossuth Lajos Tudomanyegyetem Izotoplaboratoriuma, Debrecen, Hungary); Bolyos, A.; Duflo, M. Izotoptechnika.; 18: No. 5, 208-220(May 1975). (In Hungarian).

Deposition of $^{212}Pb^{2+}$ and $^{65}Zn^{2+}$, kinetics and mechanism, and critical deposition potentials are given. (auth)

24212 PREPARATION OF CARRIER-FREE ^{67}Ga FROM PROTON-IRRADIATED Zn. Gureev, E. S.; Islamov, T.; Usachenko, V. S. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 86-87(1975). (In Russian).

Metallic Zn, irradiated with 18-MeV protons for 30 hr, was dissolved in 10M HCl. The ^{67}Ga present was extracted with HDEHP, which does not extract Zn, and stripped with HCl or HNO_3. The physical chemical properties of the product after standing for 5 days showed the presence of high-purity ^{67}Ga. (tr-auth)

24213 CHEMICAL EFFECTS IN THE COLLECTION OF MERCURY ISOTOPES WITH THE He-JET TRANSPORT METHOD. Cabot, C.; Deprun, C.; Gauvin, H.; Le Beyec, Y.; Lefort, M. (Paris-11 Univ., 91 - Orsay (France). Lab. de Chimie Nucleaire). Nucl. Instrum. Methods; 125: No. 3, 397-400(15 Apr 1975).

The helium-jet system in use at Orsay is briefly described. An experiment was performed which demonstrates the importance of the choice of the impurities added to the He gas carrier. Mercury isotopes produced in the reactions $^{144}Nd(^{40}Ca,xn)^{184-x}Hg$ are not collected by the helium-jet method under normal conditions. It is shown that the addition of iodine (which easily reacts with mercury) to the helium gas is a very efficient way to collect the mercury isotopes. (auth)

Reactor Fuel Reprocessing

Refer also to abstract 25383.

24214 (CONF-750822-6) STATUS OF ANSI STANDARDS ON DECOMMISSIONING OF NUCLEAR REPROCESSING FACILITIES. Graham, H. B. (Oak Ridge National Lab., Tenn. (USA)). 1975. 7p. Dep. NTIS $4.00.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

A definition of decommissioning is given, and the preparation of ANSI Standard, "General Design Criteria for Nuclear Reprocessing Facilities" (N101.3) is discussed. A Eurochemic report, entitled "The Shutdown of Reprocessing Facilities–Results of Preliminary Studies on the Installations Belonging to Eurochemic," was used in the preparation of this standard. (LK)

24215 (DOCKET-50201-167) WEST VALLEY REPROCESSING PLANT. License CSF-1, Proposed Change to Technical Specification 4.3. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 4 Aug 1975. 38p. Dep. NTIS $5.00.

Proposed changes to Technical Specification 4.3 Canister Loading and Spacing are given. In support of the proposed change, NFS conducted safety analyses which demonstrate the substantial safety margins remaining after the change. A summary of these analyses is included. (LF)

24216 (DOCKET-50201-168) WEST VALLEY REPROCESSING PLANT. Responses to Questions on Waste Storage. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 22 Apr 1975. 60p. Dep. NTIS $6.00.

Responses to questions on waste storage are given. The questions concerned sludge and supernate chemical composi-

tions, tank construction details, actual curie count and projected decays, concentration of plutonium in the supernate and sludge, physical properties of supernate and sludge, soil properties and description of geology of the site, site area available for additional waste management facilities, concentration of alpha emitters other than Pu, inventory of fission products and actinides in sludge and supernate, amount of sludge, inventory estimate of the amount of mercury added to the tanks, production schedule, NFS prediction of tank life, and NFS data on limit values for tank and vault temperature and stress loadings. (LK)

24217 (DOCKET-50201-169) WEST VALLEY REPROCESSING PLANT. Safety Analysis Report, Supplement 16. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 6 Aug 1975. 61p. Dep. NTIS $6.25.

Supplement 16 includes updated information for Chapter III on Design Criteria and Chapter VIII on Management Systems. The entire Chapter IX on Quality Assurance is provided. (LK)

24218 (ICP-1073) EVALUATION OF A CONTINUOUS SOLID BOWL CENTRIFUGE FOR PROCESSING SIMULATED ROVER DISSOLVER EFFLUENT. Vavruska, J. S.; Rindfleisch, J. A. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Jun 1975. Contract E(10-1)-1375. 23p. Dep. NTIS $4.00.

Pilot-plant studies using a plant-scale continuous Bird centrifuge were made to determine the solids-liquid separation and subsequent solids washing efficiencies for processing simulated Rover dissolver effluent. The studies were undertaken to provide a basis for acceptance of the continuous solid bowl centrifuge as a method of solids-liquid separation and solids washing in the Rover process. Test results showed the solid bowl centrifuge reduced the undissolved solids content of the liquid effluent to a level compatible with the TBP extraction system in the range of flow rates studied. Although wash injection nozzles were located within the centrifuge bowl, little or no washing of occluded uranium from the solids was possible. The most effective removal of occluded uranium, and thus the most efficient uranium recovery, resulted from repulping undissolved solids in water in two or more stages and recycling the repulped slurry through the centrifuge. Discharged solids were in the form of a fluid mass after the initial centrifugation and all subsequent repulp stages. Pilot-plant experience indicates the plant centrifuge should operate satisfactorily under remote conditions. Troublefree operation should result if there is no significant deviation from process conditions specified in the Rover flow sheet and operating procedures outlined. (auth)

24219 (RL-SEP-352) OPERATIONAL REPORT ON THE PUREX PLANT THORIUM PROCESS TEST. Duckworth, J. P.; Harlow, D. G.; Herrington, C. C. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 15 Mar 1965. Contract AT(45-1)-2130. 76p. Dep. NTIS $7.00.

The Purex Plant Thorium Process Test was successfully completed February 10, 1965, after 25 days of processing. The three special products were: 2886 g of ^{233}U, 7660 lb of Th, and 4 g of ^{233}Pa. The ^{233}U was 95.5 percent pure. The test demonstrated that irradiated thoria fuel can be processed efficiently in the Purex Plant. (LK)

24220 METHOD FOR DISSOLVING CERAMIC BERYLLIA. Sands, A. E. (to U. S. Energy Research and Development Administration). US Patent 3,879,520. C01g56/00. 22 Apr 1975. Filed Date 31 Jan 1963. 10p.

PAT-APPL-255,740.

A process is described for dissolving a nuclear fuel composition consisting of a sintered mass containing beryllia, a nuclear fuel selected from uranium and plutonium and a stabilizing agent, sintered at a temperature of at least 1500°C to a density of about 2.7 gs/cc. The process comprises contacting said sintered mass with a stoichiometric excess of lithium oxide dissolved or dispersed in a carrier selected from lithium hydroxide, sodium hydroxide or sodium nitrate at a temperature in the range 750-850°C to convert the beryllia to lithium beryllate and thereafter recovering the nuclear fuel content of said mass. (auth)

24221 RADIOLOGICAL IMPACT ON THE ENVIRONMENT BY INTERMITTENT GASEOUS EFFLUENTS FROM FUEL-REPROCESSING PLANTS. Huebschmann, W.; Thomas, P. (Kernforschungszentrum, Karlsruhe, Ger.). pp 351-362 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

Nuclear fuel-reprocessing plants are now, and will be in the future, main sources of radioactive emissions into the atmosphere. The radiological burden to the environment is calculated for different modes of release. This may help in site selection and licensing procedures. The annual local doses at several points in the vicinity of the plant are assessed and compared for continuous, periodic, and randomly changing activity release. Most unfavourable short-time emission is also considered. All doses refer to the same activity of ^{85}Kr released annually. The emission rhythm and rate are extrapolated from the small Karlsruhe pilot plant. A 24-hour periodic or pseudoperiodic operation yields the lowest doses, if the time of the beginning of emission is suitably chosen. (auth)

24222 RADIOLOGICAL SAFETY CONSIDERATIONS IN THE SITING OF FUEL-REPROCESSING PLANTS. Krishnamony, S.; Soman, S. D. (Bhabha Atomic Research Centre, Bombay). pp 363-372 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

Fuel-reprocessing plants are characterized by a large inventory of fission products and plutonium present in the form of highly concentrated solutions in a mobile and often dispersible form. When selecting sites for plants of this type due consideration has therefore to be given to the potential exposure of the nearby population to radiation from accidentally released radioactive materials in addition to routinely released effluents. However, in contrast with reactor siting practices, where the concept of the maximum credible accident is widely used, a number of credible and relatively minor incidents will need careful consideration in evaluating the hazards of radiochemical plants. These factors are examined in this paper with the objective of formulating suitable guidelines for the siting of such a facility. (auth)

24223 CRITERIA FOR HTR FUEL-REPROCESSING PLANT SITE EVALUATION. Riedel, H. J.; Laser, M.; Merz, E.; Schnez, H. (Kernforschungsanlage, Juelich, Ger.). pp 373-383 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

No site-independent criteria exist at present for reprocessing plants, but these plants must be designed in such a manner that a suitable site can be found in nearly all important regions. Taking the criteria into account, four typical areas in the Federal Republic of Germany are considered for siting a HTR reprocessing plant. (auth)

CONTROLLED THERMONUCLEAR RESEARCH

24224 (NP-20544) TECHNOLOGY INDEX FOR PLASMA-PHYSICS RESEARCH AND FUSION REACTORS. Volume 9, Number 6. (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). 1975. 46p. (In German and English). Dep. NTIS (US Sales Only) $5.50.

Plasma Confinement and Heating

24225 (NP-20524) TEMPERATURE AND DENSITY PROFILES OF AN MHD SWITCH-ON SHOCK. Watson-Munro, C. N.; Bighel, L.; Collins, A. R.; Cramer, N. F.; Cross, R. C. (Sydney Univ. (Australia). School of Physics). Feb 1975. 15p. (ER-80). Dep. NTIS (US Sales Only) $4.00.

An experimental study of the structure of MHD switch-on shock waves propagating into partially ionized hydrogen and helium plasmas is described. The variation of electron and ion temperatures through the shock front was studied as a function of the level of preionization. When the shock propagates into an almost fully ionized plasma, the electron temperature rises well above the ion temperature due to resistive heating of the electrons. At low preionization levels however, the ion temperature rises above the electron temperature. These results indicate that ion-neutral collisions can play a dominant role in the dissipation of energy in a shock wave. (auth)

24226 (ORNL-5053, pp 50-54) HIGH-BETA PLASMAS. Barnett, C. F.; Becker, M. C.; Cobble, J. A. Jul 1975.

In Thermonuclear Division annual progress report for period ending December 31, 1974. (Oak Ridge National Lab., Tenn. (USA)).

Full power in all 24 cavities (30 kW at 18.0 GHz) was made available for routine operation in the ELMO Bumpy Torus (EBT) during the year. The observed plasmas were characterized by three regimes of plasma fluctuation level, correlated with perpendicular energy. The quietest regime, labeled T-mode, corresponded to high density (n/sub e/1 approximately 3×10^{13} cm^{-2}), attained at maximum applied power. The transition into this mode was accompanied by an abrupt increase in perpendicular energy, consistent with the original predictions concerning stability of a confined toroidal plasma component in a bumpy torus. Energetic ions are seen in this regime with a charge-exchange neutral-particle detector. Experiments on developing the several crucial diagnostics which are required to specify the electron and ion temperatures and densities unambiguously were pursued. (auth)

24227 (ORNL-5053), pp 55-63) PLASMA HEATING. Bean, L. G.; Bryant, E. H.; Cannon, D. D. Jul 1975.

In Thermonuclear Division annual progress report for period ending December 31, 1974. (Oak Ridge National Lab., Tenn. (USA)).

Much of the Plasma Heating Department effort in 1974 was centered around providing ORMAK with increased neutral injected power capability. The culmination of this effort occurred in December when four neutral injection systems were operated simultaneously on ORMAK with a combined neutral-beam power input to the plasma of 500 kW. The continuing study of the duoPIGatron ion source led to the successful ORMAK applications and has suggested initial designs for the future PLT and Doublet III systems. A test stand for developing these approximately 50-kV, approximately 50-A systems is near completion, while a test stand for developing 150-kV injection for TFTR and beyond was designed and construction is about to begin. Development of a convergent two-dimensional numerical model for cylindrically symmetric beamlets in the acceleration region of the duoPIGatron ion source has started. The model will be used in design and construction of new accelerating structures of this type. In the area of radio-frequency heating, investigations into the theory of lower hybrid heating of a tokamak plasma revealed that variations in the peak electron density and in the impurity concentrations cause significant shifts in the location of the lower hybrid resonance for a given incident wave frequency. Moreover, small variations in the impurity concentration can result in violation of the accessibility condition. A small dipole antenna was designed which will fit into the ORMAK liner through a beam port, and a 100-kW matching rf supply was designed. Calculations of the fields radiated by a linear dipole antenna indicate that such an antenna will radiate well in a magnetized plasma. (auth)

24228 PLASMA CONFINEMENT BY A PICKET-FENCE. Leung, K. N.; Hershkowitz, N.; Romesser, T. (California Univ., Los Angeles (USA). Dept. of Physics). Phys. Lett., A; 53: No. 3, 264-266(16 Jun 1975).

Limpaecher and MacKenzie (1973) have shown that a significant increase in the density of a d.c. discharge plasma can be obtained by surrounding the plasma with permanent magnets. It has recently been demonstrated that most of the increase in density is a consequence of confinement of the primary electrons (~60 eV) which produce ionization. Tran has recently reported measurements of loss current to permanent magnet pole faces and in between point cusps. However these results do not seem to be in agreement with density measurements given in the same paper. In this letter, data obtained using a current produced line cusp field in a "picket fence" configuration are presented. Direct evidence is given that primary electrons and plasma are confined by such line cusps. (auth)

Plasma Diagnostics

24229 PHOTOELECTRIC SCINTILLATION SPECTROMETER FOR PLASMA VACUUM UV EMISSION. Vekhov, A. A.; Nikolaev, R. A.; Rozanov, V. B. (Physics Inst., Moscow). Instrum. Exp. Tech.; 17: No. 6, 1789-1790(1974).

Translated from Prib. Tekh. Eksp.; No. 6, 198-199(1974).

The spectrometer has been used to examine the plasma emission from high-current pulsed discharges. The spectrometer has no diffraction grating. The analysis is based on the energy spectrum of the photoelectrons $I = I_0 \int f(h_\nu, \theta, \epsilon) \times d\theta\, \epsilon$ as ejected from the photocathode by the direct radiation. The grid analyzer acts on the total photoelectron flux I_0 emitted at right angles to the photocathode and selects electrons of energy $\epsilon \geq eU_R$ for passage to the detector. The flux I of electrons passing through the grid is accelerated to 15 kV and is recorded by a system consisting of a scintillator, light guide, and photomultiplier. The photomultiplier signal is passed to an oscilloscope. The time resolution was 10^{-6} sec, while the duration of the discharge was 10^{-4} sec, with the instrument handling 10^{11} quanta per cm^2 per sec. (auth)

24230 CONSTRUCTION OF A TEMPERATURE SCALE FOR PLASMA TEMPERATURES. Pushkarev, G. P. Meas. Tech.; 17: No. 11, 1714-1716(Nov 1974).

Translated from Izmer. Tekh.; No. 11, 49-50(Nov 1974).

Rapid advances in plasma research and application have raised the need for the temperature scale for the range 10,000 – 12,000°K; in the USSR and elsewhere research is being done on continuous-running high-temperature plasma sources, which enable one to solve this problem. Planck's formula is used to construct a temperature scale at high temperatures, which provides for simultaneous measurement of the temperature T and spectral density ϵ_λ of the radiation: $\epsilon_\lambda = 8\pi h c^2 \lambda^{-5} [\exp(hc/\lambda kT) - 1]^{-1}$, where h is Planck's constant, c is the velocity of light, λ is wavelength, and k is Boltzmann's constant. (MOW)

24231 LASER PLASMA DIAGNOSTIC USING RING RESONATORS. Haas, R. A.; Chenausky, P. P.; Freiberg, R. J. (to U. S. Energy Research and Development Administration). US Patent 3,885,874, G01b9/02, 27 May 1975. Filed Date 11 Jan 1974, 12p.

PAT-APPL-434,528.

This invention describes a system for measuring the electron number density of a plasma, which employs a laser interferometric plasma diagnostic technique and which provides significant improved time response compared to conventional laser interferometers. The method of achieving improved time response locates the plasma in one arm of a laser-excited, transmission ring resonator cavity. The response time of the interferometer is then limited only by the Q of the ring resonator cavity and is independent of the gain, the cavity Q, and the collisional lifetimes associated with the laser source. (auth)

Plasma Kinetics (General)

24232 (ORNL-5053, pp 64-71) ATOMIC CROSS SECTIONS, PLASMA DIAGNOSTICS, AND THE CONTROLLED FUSION ATOMIC DATA CENTER. Barnett, C. F.; Cisneros, C.; Crandall, D. H.; Hutchinson, D. P.; Ray, J. A.; Ricci, E.; Vander Sluis, K.; Russek, A. Jul 1975.

In Thermonuclear Division annual progress report for period ending December 31, 1974. (Oak Ridge National Lab., Tenn. (USA)).

Measurements were completed of the total and differential

angular scattering cross sections for D^- formation from D_2^+ passing through cesium vapor in the energy range 1 to 5 keV. The D^- formation cross sections are of the order of 6×10^{-16} cm^2 in this energy range with an equilibrium D^- fraction of 0.12 at 1 keV. Scattering of D^- formed at equilibrium vapor cell pressures was characterized as a $\leq 5^0$ cone angle for containment of 90 percent of the D^- ions. Theory predicts double electron capture through curve crossing to form D_2^- in a repulsive level. Electron capture cross sections were measured for O^{3+}, N^{3+}, and C^{3+} in hydrogen and for O^{3+} in helium in the energy range 15 to 80 keV. The cross sections increased slowly with increasing energy and were between 6×10^{-16} and 8×10^{-16} cm^2 in this energy range. Reflection coefficients of 1-keV H^+ reflected from copper and gold surfaces were determined. For incident 1-keV H^+, 4.8 percent of the particles are reflected as H^+ and approximately 70 percent are reflected as neutrals. Ion temperatures were determined for H_2 and D_2 EBT plasmas. Two distributions are found: (1) a high-energy component (100 to 150 eV) and (2) a low-energy component (25 to 50 eV). Far-infrared lasers (496 mu m) are being developed to measure the spatial ion temperature of plasmas by scattering techniques. Continued investigation of the H/sub alpha/ radiation from the ORMAK plasma has shown three structural features in the wavelength profile: (1) a set of satellite lines separated by 1.5 A and interpreted to be a Stark pattern caused by electric fields of 5×10^4 V/cm (2) central portion of the profile modulated by the electron plasma frequency, (3) polarization measurements confirm pi and sigma components in the Stark pattern. (auth)

24233 MAGNETIC PUMPING IN SPATIALLY INHOMOGENEOUS MAGNETIC FIELDS. Furth, H. P.; Ellis, R. A. Jr. (to U. S. Energy Research and Development Administration). US Patent 3,886,402. G21b13/04. 27 May 1975. Filed Date 7 May 1974. 19p.
PAT-APPL-467,685.
A method is described for fast radial toroidal plasma column acceleration in an average ion-ion collision time or less back and forth in the plane of the closed containment means of the ATC described in U. S. Pat. No. 3,702,163, irreversibly to heat the plasma column. In accordance with this invention, current is flowed through the toroidal and poloidal coil means of the ATC and these coils are distributed to provide an unbalanced biasing force on the toroidal, current carrying, plasma column by means of a shaped magnetic field having an unstable region between spaced apart stable regions. By modulating the shaped field the plasma column is pushed back and forth between the two stable regions. In another embodiment, the plasma current is modulated to the same end. (auth)

24234 LOCAL MEASUREMENT OF POPULATION DENSITIES AND EFFECTIVE DEPOPULATION RATES BY LASER RESONANCE FLUORESCENCE. Bergstedt, K.; Himmel, G.; Pinnekamp, F. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik 2). Phys. Lett., A; 53: No. 3, 261-263 (16 Jun 1975).
An experimental method is described, which facilitates the determination of local population densities of the n = 2 state of hydrogen in an inhomogeneous plasma that is not in thermodynamic equilibrium. Moreover a measurement of effective electronic collision rates that give rise to a depopulation of the state n = 3 was possible. (auth)

24235 PLASMA TURBULENT REACTORS: AN ASTROPHYSICAL PARADIGM. Norman, C. A.; ter Haar, D. (Oxford Univ. (UK). Dept. of Theoretical Physics). Phys. Rep.; 17: No. 6, 307-358(May 1975).
62 refs.

Plasma Kinetics (Theoretical)

24236 (ORNL-5053, pp 28-49) PLASMA THEORY AND COMPUTATION. Arnurius, D. E.; Attenberger, S. E.; Bateman, R. G. Jul 1975.
In Thermonuclear Division annual progress report for period ending December 31, 1974. (Oak Ridge National Lab., Tenn. (USA)).
Progress in this area is reported in five sections: (1) Magnetohydrodynamic theory. The nonlinear behavior of MHD instabilities to tokamaks was studied numerically. Linear stability was also investigated, using combinations of exact and approximate methods. Two-dimensional tokamak equilibrium codes were used to ascertain the effect of an iron core transformer, and a three-dimensional equilibrium code was developed to study finite beta effects in the ELMO Bumpy Torus. (2) Kinetic theory. Numerical methods were derived to solve the drift kinetic equation, initially to study neoclassical diffusion and dissipative trapped electron instabilities in tokamaks. A parallel effort has extended the linear theory of these instabilities into experimentally relevant regimes and derived shear stabilization criteria for them. The theory of neutral beam injection into tokamaks was expanded and compared successfully with experiment. Finite-beta and electric-field effects on particle orbits in the EBT were studied. (3) Plasma modeling. One-dimensional tokamak transport codes were improved and used to study neutral beam injection and impurity effects. (4) Plasma engineering. Plasma characteristics required for break-even conditions in F-BX and TCT were determined. Prospects for burning advanced fuels such as D-D and D-^{6}Li were studied. The power balance in EBT was studied, using a zero-dimensional point model. (5) Data handling. The ORMAK data system was improved, and initial work on the EBT system was completed. (auth)

24237 (TID-26859) FIRST QUARTERLY PROGRESS REPORT ON PLASMA COMPUTATIONAL RESEARCH. (California Univ., Berkeley (USA). Electronics Research Lab.). 1 Apr 1975. Contract E(04-3)-34. 38p. Dep. NTIS $5.00.
Summaries are given of research during this period on the following topics: (1) one-dimensional electrostatic codes ES1 and ES1D2V, (2) two-dimensional electrostatic code, ES2D3V, (3) stochastic heating in ES2D3V simulations, (4) one-dimensional diffusion code, ES1D1F, (5) cold beam nonphysical instability, (6) drift cyclotron instability theory, and (7) evaluation of the stability of two-component plasmas by the Penrose criterion. (MOW)

24238 (UCB-34P128X5) INTRODUCTORY PROGRESS REPORT ON PLASMA COMPUTATIONAL RESEARCH. (California Univ., Berkeley (USA). Electronics Research Lab.). 1 Feb 1975. Contract AT(04-3)-34. 20p. Dep. NTIS $4.00.
Brief discussions are given for the following research areas: (1) one-dimensional calculations, (2) two-dimensional calculations, (3) nonphysical effects of finite numbers of particles in quiet start computer simulations, (4) drift cyclotron loss cone instability theory, (5) dispersion equation solver, (6) diffusion model using an external wave and Coulomb collision operator, and (7) evaluation of the stability of two-component plasmas by the Penrose criterion. (MOW)

24239 ECHO IN A HALF-SPACE PLASMA. Sitenko, A. G. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki); Pavlenko, V. N.; Zasenko, V. I. (AN Ukrainskoj SSR, Kiev. Inst. Geofiziki). Phys. Lett., A; 53: No. 3, 259-260(16 Jun 1975).
The paper considers the echo phenomena in a half-space plasma for the case of the mirror reflection of the electrons from plasma boundary. (auth)

24240 NOTE ABOUT THE DIPOLE APPROXIMATION IN PLASMA PHYSICS. Bourdier, A.; Di Bona, G.; Guillaneux, P. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Phys. Lett., A; 53: No. 3, 257-258(16 Jun 1975).
It is shown that the dipole approximation has a physical meaning in a relativistic theory and that, if one takes into account the electric field-spatial dependency, it is not coherent to neglect the influence of the magnetic field. (auth)

24241 QUANTUM CORRECTIONS IN DENSE IONIZED MATTER. Hansen, J. P.; Vieillefosse, P. (Paris-6 Univ., 75 (France)). Phys. Lett., A; 53: No. 2, 187-188(2 Jun 1975).
Quantum corrections to the free energy and equation-of-state of the dense on-component ionic plasma are calculated to order h^4 in the Wigner expansion. (auth)

24242 SHORT RANGE BEHAVIOR OF THE PAIR CORRELATION FUNCTION IN THE DENSE ELECTRON GAS. Deutsch, C. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique des Plasmas). Phys. Lett., A; 53: No. 2, 183-184(2 Jun 1975).
An effective Coulomb interaction taking into account the diffraction effects is used to sum the series of bubbles diagrams building up the short-range part of the pair correlation function. (auth)

Plasma Production

Refer also to abstract 24122.

Plasma Stability

24243 (MATT-1148) BOHM STABILITY CRITERION AND THE MHD THEORY OF PLASMA FLOW INTO AN ABSORBING WALL. Boozer, A. H. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Aug 1975. Contract AT(11-1)-3073. 9p. Dep. NTIS $4.00.

The consistency of the Bohm stability criterion and the MHD theory of plasma flow into an absorbing wall is shown. This provides strong evidence for the validity of an MHD analysis of the complex problem of plasma flow into a divertor. (auth)

24244 DEPLETION SATURATION OF PARAMETRIC INSTABILITIES. Yuen, S. Y. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). Phys. Lett., A; 53: No. 2, 185-186(2 Jun 1975).

Analytic expressions are presented for the depletion-saturated plasma wave energies for parametric instabilities. The results are in good agreement with simulation experiments. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 24134, 24147, 24148, 24155, 24275, and 24315.

24245 (ERDA-tr-53) DEVELOPMENT OF MEANS OF OBTAINING INTENSIVE FLUXES OF FAST PARTICLES FOR THERMONUCLEAR DEVICES IN THE USA. Semashko, N. N. Translated from At. Energ. (USSR); 38: No. 5, 348-349(1975). 6p. Dep. NTIS $4.00.

The brief review covers research done at Berkeley (LBL), Livermore (LLL), and Oak Ridge (ORNL). The history and present status of injector research at each laboratory are described. (MOW)

24246 (LA-UR-75-1510) SUPERCONDUCTING MAGNETIC AND INERTIAL ENERGY PULSED POWER SYSTEMS. Swannack, C. E.; Williamson, K. D. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 32p. (CONF-750723-13). Dep. NTIS $4.75.

From international conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

Superconducting magnetic and inertial energy pulsed power systems are being developed for future theta-pinch, Tokamak, and laser fusion applications. The short term requirements for these applications are discussed along with present day accomplishments. Areas requiring a research and development effort are examined in detail. Subjects discussed include stresses, energy loss factors, conductor metallurgy, cryogenic requirements, and electrical limitations of superconducting magnetic storage systems; costs, applications, and present technology of homopolar systems; and switching problems associated with both systems. (auth)

24247 (ORNL-5053) THERMONUCLEAR DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1974. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 124p. Dep. NTIS $5.45.

Separate abstracts were prepared for 8 of the included sections. (MOW)

For abstracts of individual sections see: 24226, 24227, 24232, 24236, and 24248–24251.

24248 (ORNL-5053, pp 1-27) LOW-BETA PLASMA DEPARTMENT. Berry, L. A.; Anderson, J. L.; Bates, D. D. Jul 1975.

In Thermonuclear Division annual progress report for period ending December 31, 1974. (Oak Ridge National Lab., Tenn. (USA)).

A feedback system was installed and operated for discharge-major-radius control based on a good understanding of plasma equilibrium. Major efforts were begun in surface physics and relativistic electron physics. The physics of the formation and acceleration of runaway electrons is discussed. In the area of neutral injection studies, a model to explain the apparent lack of heating for a counter-injected beam was developed and substantiated experimentally. This model predicted that counterinjection would become more efficient as the plasma current was increased, and this was verified by experiment. In the area of plasma confinement, the radial features of various transport models are being compared with experimental results. (MOW)

24249 (ORNL-5053, pp 72-79) SUPERCONDUCTIVITY, MAGNETICS, CRYOGENICS, AND VACUUM COATING. Akin, J. E.; Ballou, J. K.; Beaver, R. J. Jul 1975.

In Thermonuclear Division annual progress report for period ending December 31, 1974. (Oak Ridge National Lab., Tenn. (USA)).

The Engineering Sciences Department continued to provide consultation, design, and experiment to support the plasma physics activities of the Division while inaugurating a comprehensive program to develop superconducting magnets for toroidal fusion devices. This newly funded program is aimed at producing toroidal superconducting magnets for an experimental power reactor by the mid 1980's. Other superconducting work, such as the 14-T niobium tin solenoid designed last year for use in Moessbauer experiments, has been fabricated, successfully tested, and delivered to the Physics Division. This coil, which used a 1.27-cm wide Nb_3Sn conductor operating at 14 T with a coil current density of 11,000 A/cm, represents an advance in the state-of-the-art. The conceptual design was provided for a subcooler to extend the ORMAK operating temperature to 70°K and thus allow operation at fields up to 25 kG with the present generators. The detailed design, fabrication, installation supervision, and acceptance testing of the subcooler were provided by the UCCND engineering organization. Further support to the ORMAK program was provided by the vacuum-coating activity through an investigation of sputtering erosion of the ORMAK liner. In addition, a program was undertaken to develop a variety of refractory surfaces of metals, alloys, and intermetallic compounds on stainless steel for use as first walls in future fusion devices. Adherent thick-film metallic and compound coatings deposited in vacuum by several mechanisms were produced and tested. (auth)

24250 (ORNL-5053, pp 82-90) FUSION REACTOR TECHNOLOGY. Alsmiller, R. G.; Amburgey, J. O.; Bamberger, C. E. Jul 1975.

In Thermonuclear Division annual progress report for period ending December 31, 1974. (Oak Ridge National Lab., Tenn. (USA)).

During the past year, the major accomplishments of the Fusion Reactor Technology Program have included the following items: (1) the effects of high fluence and high helium concentrations on the swelling and mechanical properties of type 316 stainless steel have been evaluated. (2) A critical review of corrosion studies for iron-based alloys in lithium has been completed. (3) The cross-section sensitivity of the tritium breeding ratio in a variety of fusion reactor blanket designs has been analyzed. (4) A CTR nuclear data library has been initiated by the Radiation Shielding Information Center for the fusion community. (5) Neutron sputtering experiments using the $^9Be(d,n)$ reaction exhibited yields no greater than 10^{-4} per neutron, and no chunk emission was observed. (6) A comparative study of the more promising combinations of blanket materials, power conversion systems, tritium recovery systems, and tritium containment systems has been completed. (7) The dynamic overall energy balance of clean and impurity-contaminated tokamak reactors has been investigated. (8) The conceptual design of a plasma-exhaust tritium-recovery system has been completed. (auth)

24251 (ORNL-5053, pp 91-115) ADVANCED SYSTEMS PROGRAM. Roberts, M.; Legg, A. M.; Mosko, S. W.; Haubenreich, P. N.; Jernigan, T. C.; Cherdack, R. N.; England, A. C. Jul 1975.

In Thermonuclear Division annual progress report for period ending December 31, 1974. (Oak Ridge National Lab., Tenn. (USA)).

In the experimentally related area, three tasks were worked on in 1974. The design, construction, and installation of the third and fourth injection systems for ORMAK was completed by the end of the year. The design and major procurement for the ORMAK solid-state power system was completed and some parts of the substation installation completed. Initiation of rf heating studies was begun early in the year with surveys of the literature, small-scale experiments, plans for participation in large devices, and theoretical analyses of impurity effects; this rf work was transferred to the Plasma Heating Department at year's end. In the area of advanced systems designs, the year opened with intensive consideration of ORMAK F/BX as a candidate for the Tokamak Fusion Test Reactor culminating in a design study proposal in midyear. Following the decision to make TFTR a water-cooled coil TCT at the Princeton Plasma Physics Laboratory, the design team turned its attention to a scoping study of the experimental power reactor aimed at identifying the major components and problems in an EPR as a guide to further design and continued research and development. For the nearer term than TRTR, a design was developed aimed at elucidating plasma impurity problems and potential solutions emphasizing wall effects and control. This design, entitled ORMAK II, was based upon superconducting toroidal field coils as the principal design and was also carried with water-cooled toroidal field coils as an alternative. At year's end, the ORMAK II design study was combined with basic needs of the technology program into a comprehensive parameter study aimed at a technology-oriented program based upon a device entitled the Technology Test Assembly. (auth)

24252 (ORNL-tr-4001) LOADING OF PLUG-IN COPPER CONTACTS WITH HIGH DIRECT CURRENTS. Schwartz, U.;

Winkler, H. (Technische Univ. Braunschweig (F. R. Germany)). 23 May 1975. Translated by R. G. Mansfield from Research Report No. 117. 13p. Dep. NTIS $4.50.

A description and evaluation are given of high-current-loading experiments on plug-in copper contacts. The report concerns loading experiments on plug-in contact systems in which the contact is made through simple interchangeable and prestressed multicontact strips. Since two of the contact systems are provided with cooling channels, there are two objectives of the report: (1) comparison of the plug-in contact systems with the previously studied flat contact systems with respect to behavior of the resistance and temperature upon loading, and (2) description of the effect of forced cooling with water during the loading on the behavior of the contacts. (auth)

24253 (UCID-16869) CLAMSHELL TESTS. Sonderman, J. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Aug 1975. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

The results are given of optical tests of one copper and two silver plated beryllium ellipsoidal (clamshell) mirrors diamond turned by the Metrology Group and tested by the Optics Group at LLL. The 30 cm diameter mirrors are to be used for focusing intense laser light onto pellet targets for the laser fusion effort. Since no single optical test could be found to adequately evaluate the surface or its spot image, geometrical figure was measured by an interferometer and surface scatter was measured by a knife edge test. Copies of representative interferograms are given with their graphical analysis and knife edge test data for one copper and silver mirror. All tests were made using $\lambda = 0.633\mu m$ light. Surface reflectivity was not measured but will be at least 0.98 for the silver and 0.97 for the copper based on previous measurements. (auth)

24254 (UCRL-13640) LASER FUSION SYSTEMS DESIGN STUDY. Final Technical Report. (Perkins-Elmer Corp., Norwalk, Conn. (USA)). Jun 1975. Contract 5379315. 314p. Dep. NTIS $18.75.

For Univ. of California. Lawrence Livermore Lab.

This study investigated: (1) the formulation and evaluation of an alignment system to accomplish pointing, focusing, centering and translation for the 20-arm SHIVA laser, (2) the formulation and evaluation of concepts for the correction of static phase distortions introduced by the accumulated optical elements in the laser chains, (3) the formulation and evaluation of concepts for the correction of optical path length differences between the arms of the SHIVA system, and (4) the conceptual design of appropriate control system hardware. (MOW)

24255 (UCRL-13640(Add)) LASER FUSION SYSTEMS DESIGN STUDY. Final Technical Report. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1975. Contract 5379315. 14p. Dep. NTIS $4.00.

This document is an addendum to Perkin-Elmer Report No. 12486, Final Technical Report, Laser Fusion System Analysis. Contained herein are the budgetary cost estimates prepared for the baseline design described in the Final Technical Report. Cost tradeoffs performed during the study are covered. (auth)

24256 (UCRL-75880) PELLET DESIGN FOR A LASER FUSION REACTOR. Thiessen, A. R.; Nuckolls, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Oct 1974. 17p. (CONF-741079-16). Dep. NTIS $4.00.

From 16th annual meeting of the plasma physics division of the American Physical Society; Albuquerque, New Mexico, USA (28 Oct 1974).

The requirements for laser fusion pellet design are discussed. Computer calculations are presented of a capsule consisting of a spherical solid drop of DT surrounded by a concentric shell of DT. Gains greater than 40 fold are achieved with laser energies of approximately 0.5 MJ, and peak powers of about 10^{16} W. (MOW)

24257 (UCRL-76729) TRANSFER OPERATIONS WITH TRITIUM: A REVIEW. Folkers, C. L.; Gede, V. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Jun 1975. 33p. (CONF-751101-1). Dep. NTIS $4.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Controlled thermonuclear reactors will involve pumping operations with tritium that may involve pressures ranging from submillipascals to megapascals. A variety of pumps are available that can cover portions of this range, and these can be staged to cover the entire pressure range. Some of these pumps can be adapted to virtually any size requirement currently anticipated. Special attention must be paid to operating features and construction materials. (auth)

24258 LASER POSSIBILITIES IN PULSED CONTROLLED THERMONUCLEAR FUSION. Shearer, J. W. (Univ. of California, Livermore). pp 14-27 of Applications of Cryogenic Technology. Vol. V. Carr, R. H. (ed.). Whitestone, NY; Scholium International, Inc. (1973).

From 5th annual conference of the Cryogenic Society of America; Chicago, Illinois, USA (3 Oct 1972). See CONF-721023-.

Two possibilities for using lasers in controlled fusion reactors are discussed. In the first, the laser would be used to heat a deuterium plasma in a uniform magnetic field similar to "conventional" fusion machine concepts. Large cryogenically cooled coils would be needed to provide fields of a hundred kilogauss or greater. In the second proposal, small thermonuclear "microexplosions" would be created in a thick-walled vacuum chamber by means of a spherical array of laser beams focused on small spherical pellets of solid heavy hydrogen. These pellets must be prepared cryogenically and propelled into the vacuum chamber. This controlled fusion concept does not require a magnetic field for containment because the pellet plasma is so dense that sufficient nuclear reactions occur before it comes apart. The proposal involves questions of explosion magnitude and repetition rate, efficiencies of laser operation and light absorption, and energy recovery. (auth)

24259 ENGINEERING FEASIBILITY OF A FUSION REACTOR. Boom, R. W.; Kulcinski, G. L.; Maynard, C. W.; Vogelsang, W. F. (Univ. of Wisconsin, Madison). pp 221-243 of Applications of Cryogenic Technology. Vol. V. Carr, R. H. (ed.). Whitestone, NY; Scholium International, Inc. (1973).

From 5th annual conference of the Cryogenic Society of America; Chicago, Illinois, USA (3 Oct 1972). See CONF-721023-.

Potentialities and design problems of a Tokamak fusion reactor are discussed, using a 1000 MW plant as an example. Immense superconducting magnets are required to confine the reacting plasma to its toroidal shape. New structural materials are needed, especially to contain the neutron moderator in a severe temperature and radiation environment. Maintenance requirements must be minimal, since the structure will be radioactive for years, perhaps decades after shutdown. (auth)

24260 IMPROVED METHOD FOR EXCITING INDUCTIVE-RESISTIVE LOADS WITH HIGH AND CONTROLLABLE DIRECT CURRENT. Hill, H. M. Jr. (to U. S. Energy Research and Development Administration). US Patent Application 537,809. Filed date 31 Dec 1974. 21p.

Apparatus and method for transmitting dc power to a load circuit by applying a dc voltage from a standard waveform synthesizer to duration modulate a bipolar rectangular wave generator. As the amplitude of the dc voltage increases, the widths of the rectangular wave generator output pulses increase, and as the amplitude of the dc voltage decreases, the widths of the rectangular wave generator output pulses decrease. Thus, the waveform synthesizer selectively changes the durations of the rectangular wave generator bipolar output pulses so as to produce a rectangular wave ac carrier that is duration modulated in accordance with and in direct proportion to the voltage amplitude from the synthesizer. Thereupon, by transferring the carrier to the load circuit through an amplifier and a rectifier, the load current also corresponds directly to the voltage amplitude from the synthesizer. To this end, the rectified wave at less than 100 percent duty factor, amounts to a doubled frequency direct voltage pulse train for applying a direct current to the load, while the current ripple is minimized by a high L/R in the load circuit. In one embodiment, a power transmitting power amplifier means having a dc power supply is matched to the load circuit through a transformer for current magnification without sacrificing load current duration capability, while negative voltage and current feedback are provided in order to insure good output fidelity. (auth)

24261 LASERS FOR FUSION. McGeogh, M. (Imperial Coll. of Science and Tech., London). New Sci. (London).; 67: No. 959, 205-207 (24 Jul 1975).

For experiments on laser fusion to proceed at any reasonable speed and in sufficient variety, there must be substantial gains in laser efficiency and reliability. The merits and demerits of neodymium-glass, carbon dioxide and photochemical iodine lasers as candidates for laser fusion are considered. The requirement is for a gas laser of at least 10% efficiency, easily scaled up to energies of about 10 kilojoules, and operating at a wavelength of about 0.4 micrometers. Methods of searching for a new laser system are discussed. The relevance of the choice of transition (the pair of initial and final energy levels of the atom or molecule participating in the process of light emission) on energy storage is stressed. (UK)

Wave Phenomena

24262 (JINR-P9-8698) MODIFIED BOUSSINESQ EQUATION AND NONLINEAR WAVE DYNAMICS. Bogolyubskii, I. L. (Joint

Inst. for Nuclear Research, Dubna (USSR)). 1975. 23p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

Modified Boussinesq equation is studied both analytically and by computer. Head-on-collisions of solitons turn out to be inelastic and coefficient of inelasticity seems to grow up when amplitude of counter solitons increases. A closed equation was obtained and investigated which describes the dynamics of nonlinear ion-sound waves. (auth)

24263 STRONG MICROWAVE ABSORPTION IN AN OVERDENSE PLASMA LAYER. Beerwald, H.; Boehm, G.; Kampmann, B.; Schweer, B. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik 2). Phys. Lett., A; 53: No. 3, 267-268 (16 Jun 1975).

A method is described to achieve virtually full absorption of microwave power in an overdense plasma column of low collision frequency. (auth)

24264 EXPERIMENTAL OBSERVATIONS OF THE DIMENSIONLESS SCALING OF PLANAR AND CYLINDRICAL ION ACOUSTIC SOLITONS. Romesser, T. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy); Hershkowitz, N. (California Univ., Los Angeles (USA). Dept. of Physics). Phys. Lett., A; 53: No. 2, 180-182(2 Jun 1975).

An experimental comparison of planar and cylindrical ion acoustic solitons is made through the use of dimensionless scaling parameters. The Korteweg de Vries equation is found to be insufficient to completely explain the observed data. (auth)

ENGINEERING

Energy Conversion

24265 (AEC-tr-7314, pp 166-173) SEMICONDUCTOR VOLTAGE CONVERTERS FOR RADIOISOTOPIC THERMOELECTRICAL GENERATORS. Korotkov, N. P.; Kodyukov, V. M.; Malyshev, A. Ya.; Sapelkin, B. P.; Dmitriev, A. I.; Fradkin, G. M. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Circuit diagrams and performance of semiconductor voltage converters for radioisotope-powered thermoelectric converters are presented. (TFD)

Facilities and Equipment

Refer also to abstracts 24326 and 24432.

24266 (ARH-SA-223) DEMOLITION AND REMOVAL OF PLUTONIUM-CONTAMINATED FACILITIES AT HANFORD. Raile, M. N. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2130. 40p. Dep. NTIS $5.00.

The successful demolition and cleanup of a plutonium-contaminated facility at the U. S. Energy Research and Development Administration Hanford Plant in Washington State are described. Several new materials, along with special techniques and equipment, were utilized for the containment and control of plutonium contamination during the course of the demolition work. The use of light-capacity fiberglassed plywood boxes for long-term (20-year, minimum) storage of the contaminated materials in underground transuranic waste trenches has led to the development, design and use of larger capacity modular fiberglassed plywood boxes that are replacing standard carbon steel boxes at less than one-third the cost, and without the potential for early failure from normal soil or atmospheric corrosion. (auth)

24267 (UCRL-50028-75-1, pp 23-27) COMPUTER SIMULATIONS GROUP. Norris, D. M. 1975.

In H-Division quarterly report, January-March 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

This group is responsible for calculations in the area of solid mechanics. The objective is to build in-house expertise both in the Lagrangian finite-difference HEMP-type codes and in the finite-element codes traditionally used in structural statistics and dynamics. Work currently underway includes the three-dimensional analysis of a gas-turbine-stator blade, definition of missile-silo environment from penetrating nuclear weapons, and aircraft-hangerette vulnerability. Code development associated directly with this work includes modification of finite-difference and finite-element computer programs and the companion graphics software. (auth)

24268 APPARATUS AND METHOD FOR LARGE TUNNEL EXCAVATION IN SOFT AND INCOMPETENT ROCK OR GROUND. Altseimer, J. H.; Hanold, R. J. (to U. S. Energy Research and Development Administration). US Patent 3,881,777, E21c9/04. 6 May 1975. Filed date 25 Jan 1974. 10p.

PAT-APPL-436,402.

A tunneling machine is described for producing large tunnels in soft rock or wet, clayey, unconsolidated or bouldery earth by simultaneously detaching the tunnel core by thermal melting a boundary kerf into the tunnel face and forming a supporting excavation wall liner by deflecting the molten materials against the excavation walls to provide, when solidified, a continuous wall supporting liner, and detaching the tunnel face circumscribed by the kerf with powered mechanical earth detachment means and in which the heat required for melting the kerf and liner material is provided by a compact nuclear reactor. (auth)

24269 APPARATUS AND METHOD FOR LARGE TUNNEL EXCAVATION IN HARD ROCK. Altseimer, J. H.; Hanold, R. J. (to U. S. Energy Research and Development Administration). US Patent 3,885,832. E21d9/00. 27 May 1975. Filed date 25 Jan 1974. 10p.

PAT-APPL-436,401.

A tunneling machine is described for producing large tunnels in rock by progressive detachment of the tunnel core by thermal melting a boundary-kerf into the tunnel face and simultaneously forming an initial tunnel wall support by deflecting the molten materials against the tunnel walls to provide, when solidified, a continuous liner; and fragmenting the tunnel core circumscribed by the kerf by thermal stress fracturing and in which the heat required for such operations is supplied by a compact nuclear reactor. (auth)

24270 ARCHIVE-CUP INSERT FOR LIQUID-METAL SAMPLING. Nelson, P. A.; Kolba, V. M.; Filewicz, E. C.; Holmes, J. T. (to U. S. Energy Research and Development Administration). US Patent 3,881,355. G01n1/14. 6 May 1975. Filed date 30 Oct 1973. 12p.

PAT-APPL-411,127.

An insert for collecting liquid-metal samples within a vertical casing including an elongated housing with an upper and a lower overflow seal of annular shape is described. The lower seal includes a centrally located pedestal on which a sample cup is disposed. Liquid metal enters the annulus of the upper seal and overflows into the cup which fills and overflows into the lower seal. Liquid-metal overflow from the lower seal is discharged from the insert. On cooling, the liquid metal trapped within the seals solidifies to hermetically isolate the metal sample within the cup. The device is particularly applicable for use with sampling systems on liquid metal-cooled reactors. (auth)

Lasers

24271 (AD/A-003316) FLAME SHEET MODEL FOR A DIFFUSION-TYPE HF CHEMICAL LASER. Final Report. Hayday, A. A. (Scicom, Inc., Huntsville, Ala. (USA)). Sep 1973. Contract DAAH01-72-C-1088. 97p. (RK-CR-73-1). NTIS $4.75.

A theory describing the flow field near the entrance to the cavity of a continuous wave chemical laser is presented. The HF chemistry is considered in some detail but the point of view is general and applicable to other chemistries. The theory yields criteria for limiting flow regimes and establishes the influence of several key parameters explicitly. In particular, the important role played by the diluents in inhibiting collisional deactivation is discussed on the basis of the macroscopic flow equations. Laminar and turbulent flows are treated on a unified basis; the latter are discussed from the phenomenological point of view. First approximations for the case of a diffusion flame are obtained and an appropriate perturbation technique describing collisional deactivation is developed. The diffusion limited case is shown to be a valid approximation to several systems now operating. Radiative interactions are considered for a medium near saturation. Possible rotational nonequilibrium effects are discussed briefly. (GRA)

24272 (LA-5986-MS(Vol.1)) OPTICAL DESIGN OF A REACTION CHAMBER FOR WEAKLY ABSORBED LIGHT. I. Canted and Parallel Mirrors (With an Appendix for Strongly Absorbed Light Waves). Devaney, J. J.; Jackson, D. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1975. Contract W-7405-ENG-36. 19p. Dep. NTIS $4.00.

The optimization of light absorption in a weakly absorbing medium is studied by repeatedly reflecting a light beam from either plane or cylindrical canted and parallel mirrors. Vertical control is exerted either by horizontal mirror reflection, by cylindrical end mirrors, or by well-collimated or focused beams. Useful absorption for a number of numerical parameters is calculated. The gross properties of lasers are characterized for geometrical optical purposes. Beam insertion optics are evaluated. Chamber and mirror energetics are considered. The shape and speed of a light beam eating its way into a very highly absorbing medium are given. (auth)

24273 (LA-5986-MS(Vol.2)) OPTICAL DESIGN OF A REACTION CHAMBER FOR WEAKLY ABSORBED LIGHT. II. Parallel Mirrors, Multitravel. Devaney, J. J.; Finch, F. T. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1975. 9p. Dep. NTIS $4.00.

This report outlines the possibilities to be found using one or more diffraction-limited high-quality light beams to activate a weakly absorbing gas in a regime where the diffraction spread can be controlled by converging optical devices to within a ratio of root2 of the minimum at the beam waist (corresponding lengths between converging elements are within twice the Rayleigh range). Our designs use plane or cylindrical parallel mirrors down which a light beam is repeatedly reflected. In the first design variation, the beam is re-reflected up the parallel mirrors to the entrance aperture where it can be returned repeatedly for a number of multiply reflecting "travels" up and down the parallel mirror reaction chamber. In the second variation, the return of the beam after each multiply reflecting "travel" down the chamber is

external to the chamber and is achieved by two mirror reflections. For diffraction control the return mirrors can be made converging. For multiple laser excitation, any of the external return mirrors can be replaced by a laser. The advantage of these designs is a high degree of uniformity of chamber illumination with a reasonably high number of passes. Drawbacks of the designs are the large space needed for beam return (many tens of meters for some parameters) and (common to all high optical quality chambers) the figuring and reflectivity demands on the mirrors. (auth)

24274 (LA-5986-MS(Vol. 3)) OPTICAL DESIGN OF A REACTION CHAMBER FOR WEAKLY ABSORBED LIGHT. III. Asymmetric Confocal Resonator. Devaney, J. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1975. Contract W-7405-ENG-36. 15p. Dep. NTIS $4.00.

An asymmetric confocal resonator is studied for the purpose of maximizing useful absorption in the enclosed medium. Ray matrices are developed, the product of which may be rendered in a very simple form when the number of passes is an integral power of 2. Simple approximate ray matrix products are also presented for any pass number. Ray positions are computed for a beam of width 2C and divergence delta. The value of delta for maximum absorption is determined. A simple optical system for optimum beam insertion is examined. An elementary characterization of lasers is developed consisting of a disk source plus a lens or aperture. Optimum chamber parameters are given. Beam and image sizes as a function of pass number are given with consequent beam energy densities. Integrated energy densities on the mirrors and at focus are given. Numerical examples are given for a near diffraction-limited beam laser and a X50 diffraction-limited beam laser. Closed form expressions for the useful absorption of the medium are derived when absorber depletion is negligible. The pass-numbers for arrival of the beam at the center, for the minimum beam size, and for commencement of beam leakage out of the chamber are determined. We present an order of magnitude correction for beam depletion and evaluate the (depleted) beam absorption by HP-9820A computer. We tabulate a number of representative numerical results and give comparisons with other chambers. (auth)

24275 (SAND-75-5659) SANDIA HIGH-POWER ATOMIC IODINE PHOTODISSOCIATION LASER. Palmer, R. E.; Padrick, T. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 6p. (CONF-750914-4). Dep. NTIS $4.00.

From second summer colloquium on electronic transition lasers; Woods Hole, Massachusetts, USA (17 Sep 1975).

One of the more promising candidates for a laser to demonstrate the feasibility of laser fusion is the 1.315 mu atomic iodine laser. In a relatively short time it has been developed into a viable subnanosecond, high energy laser. Although at present the iodine laser cannot equal the output capabilities of a large Nd:glass laser system, there are no foreseeable obstacles in the construction of a 100 psec, 10 KJ or greater atomic iodine laser system. A 100 joule system being constructed at Sandia to investigate many of the scaling parameters essential to the design of a 10 KJ or greater system is described. (auth)

24276 (UCID-16860) FLASHLAMP PUMPING OF ED-2. Holzrichter, J. F.; Donich, T. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Nov 1973. Contract W-7405-Eng-48. 24p. Dep. NTIS $4.25.

Several aspects of the optical engineering of xenon flashlamps as applied to ED-2 glass-laser systems were investigated. The primary purpose of this work was to normalize the xenon flashlamp models which have been used to estimate laser energy requirements. The following aspects of flashlamp pumping were measured by using a 1 cm bore, 127 cm long, 450 torr xenon flashlamp: (1) the absorption of visible flashlamp radiation as a function of Nd concentration in ED-2 laser glass and the absorption of uv flashlamp radiation by the Ce in ED-2 laser glass; (2) the pumping efficiency of ED-2,3 laser glass as a function of pulse duration and energy loading; and (3) the absolute electrical to optical conversion efficiency as a function of energy loading and current density. Results of the investigation show that the absorption of flashlamp light in ED-2 laser glass is accurately predicted by the present lamp model. (TFD)

24277 (UCID-16884) HIGH POWER UV METAL VAPOR ION LASERS PUMPED BY THERMAL ENERGY CHARGE EXCHANGE. Kan, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Aug 1975. Contract W-7405-Eng-48. 49p. Dep. NTIS $5.50.

The requirement for efficient and scalable laser sources for laser isotope separation (LIS) has recently been brought into sharp focus. The lack of suitable coherent sources is particularly severe in the uv, a spectral region of interest for more efficient and advanced isotope separation schemes. This report explores the general class of metal vapor ion lasers pumped by thermal energy charge exchange (TECX) as possible scalable coherent sources for LIS with the following potential characteristics: (1) availability of discrete wavelengths spanning the wavelength region between 2000 A less than lambda less than 8000 A, (2) pulsed or cw operation in the multi-kilowatt average power levels, (3) overall device efficiencies approaching one percent, and (4) the engineering of practical laser devices using relatively benign electron beam technology. (auth)

24278 (UCRL-13637) SPECTROSCOPY OF NEODYMIUM IN LASER GLASSES. Final Report, 15 December 1972-14 December 1973. DeShazer, L. G.; Ranon, U.; Reed, E. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1974. 55p. Dep. NTIS $5.75.

Energy level, linewidths and oscillator strengths for Nd^{3+} in ED2 glass were determined from the fluorescence and absorption spectra. The spectra were interpreted by variations produced by changes in glass temperature from 4 to 300°K. Branching ratios were determined for ED2,3 glass taking into account the self-absorption correction for the 0.9 mu m fluorescence. Preliminary spectroscopic measurements were performed on Hoya LSG-91 glass. (auth)

24279 (UCRL-51873) CALORIMETRIC MEASUREMENTS OF LASER ENERGY AND POWER: 1975 SUPPLEMENT. Gunn, S. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jul 1975. Contract W-7405-Eng-48. 23p. Dep. NTIS $4.00.

The use of calorimeters for measuring laser output energies and powers is reviewed, primarily for the period 1972-1975 since preparation of an earlier review. (auth)

24280 CO_2 LASER GENERATING SIMULTANEOUSLY AT TWO WAVELENGTHS AND HAVING HIGH AMPLITUDE AND FREQUENCY STABILITY. Bykov, P. A.; Epifanov, V. P.; Pavlova, L. M.; Sviridov, A. N.; Solonitsyn, I. I. Instrum. Exp. Tech.; 17: No. 6, 1745-1746(1974).

Translated from Prib. Tekh. Eksp.; No. 6, 161-162(1974).

A CO_2 laser generating simultaneously at two wavelengths is described. The generation frequency is stabilized within $\sim 10^{-9}$ through the maintenance of a fixed ratio of the generation power levels at the two wavelengths. (auth)

24281 APPARATUS FOR MASS-SPECTROSCOPIC ANALYSIS OF PLASMA IN GAS-DISCHARGE LASERS. Egorov, N. P.; Komarov, V. N.; Kypriyanov, S. E.; Trubacheev, E. A.; Volchenok, V. I. (Physicochemical Scientific-Research Inst., Moscow). Instrum. Exp. Tech.; 17: No. 6, 1743-1744(1974).

Translated from Prib. Tekh. Eksp.; No. 6, 159-160(1974).

A description is given of an apparatus for the analysis of the neutral and ion components of the plasma of a gas-discharge laser both with and without stimulated emission. The particles are separated from the region of the positive column and are analyzed according to the mass to charge m/e ratio using a quadrupole mass spectrometer KM-1. (auth)

24282 MEASUREMENT OF LASER RADIATION PULSE ENERGY BY USING PHOTODIODES. Batenin, A. N.; Kukhtevich, V. I. Meas. Tech ; 17: No. 12, 1855-1858(Dec 1974).

Translated from izmer. Tekh.; No. 12, 38-40(Dec 1974).

An analysis was carried out that permits the selection, in practice, of the kind of photodiode for laser radiation pulse measurement, as well as estimation of the photodiode lode parameters which will minimize measurement errors. (TFD)

24283 DEVICE FOR MEASURING ENERGY OF RADIATION PULSES FROM A LASER OPERATING IN THE FREQUENCY MODE. Boitsov, V. A.; Vigant, Yu. V.; Grashin, Yu. M.; Dvoretskii, V. I.; Lebedev, A. S.; Perlov, D. I.; Shishov, V. L. Meas. Tech.; 17: No. 12, 1859-1862(Dec 1974).

Translated from Izmer. Tekh.; No. 12, 40-43(Dec 1974).

A semiconductor diode is used in the device as the radiant energy receiver. Although the photoelectric method is not absolute, practice shows that instruments based on it can be used successfully for measuring the energy of laser radiation pulses when calibrating these devices by means of calorimeters, bolometers, etc. An operating test of the device described for measuring the energy of laser radiation pulses showed its high sensitivity stability. The great advantage of the photoelectric method is the high rate of repetition of the measurements, which is unattainable by the use of calorimetric methods. The use of two channels of different sensitivity for measuring the energy of radiation of one wavelength makes it possible to extend the dynamic range. The number of measurement channels in principle can be even greater than two, which extends the possibility for its use in controlling the energy characteristics of a laser. (auth)

24284 DEVICE FOR VISUALIZATION AND MEASUREMENT OF SPATIAL DISTRIBUTION OF RADIATION INTENSITY IN THE TRANSVERSE SECTION OF A CO_2-LASER BEAM. Morozov, P. A.; Morozova, S. P.; Lisyanskii, B. E.; Rukman, G. I. Sholokhov, V. A.; Zhukov, A. G. Meas. Tech.; 17: No. 12, 1863-1865 (Dec 1974).

Translated from Izmer. Tekh.; No. 12, 43-44(Dec 1974).

A special optoelectronic system for measuring the spatial distribution of the radiation power density over the transverse cross section of laser beams is described. (TFD)

24285 PLASMA PUMPED LASER. Miley, G. H. (to U. S. Energy Research and Development Administration). US Patent 3,886,483. H01s3/09. 27 May 1975. Filed Date 31 Oct 1973. 14p.

PAT-APPL-411,556.

This invention relates to a laser and in particular to a laser utilizing a plasma to create a population inversion in the laser active medium. The laser can be pumped by the output plasma from a fusion reactor, for example, or by plasma from other sources. Either the plasma ions or electrons or both can be used to pump the laser. Also the plasma ions can be used to provide energy to achieve a chemical laser action. (auth)

24286 TRAVELING WAVE LASER SYSTEM. Gregg, D. W.; Kidder, R. E.; Biehl, A. T. (to U. S. Energy Research and Development Administration). US Patent 3,886,482. H01s3/09; H01s3/02. 27 May 1975. Filed Date 19 Sep 1973. 21p.

PAT-APPL-398,888.

A method is described for generating a traveling wave laser pulse of almost unlimited energy content wherein a gain medium is pumped into a traveling wave mode, the traveling wave moving at essentially the velocity of light to generate an amplifying region or zone which moves through the medium at the velocity of light in the presence of directed stimulating radiation, thereby generating a traveling coherent, directed radiation pulse moving with the amplification zone through the gain medium. (auth)

24287 SHOCKED PLATE METAL ATOM OXIDATION LASER. De Koker, J. G.; Rice, W. W. Jr.; Jensen, R. J. (to U. S. Energy Research and Development Administration). US Patent 3,876,960. H01s3/09; H01s3/22. 8 Apr 1975. Filed Date 9 May 1974. 10p.

PAT-APPL-468,314.

A method and apparatus for producing metal atom oxidation lasing wherein an explosively shocked grooved metal plate produces metal vapor jets directed through an appropriate gaseous oxidizer are described. Reaction of the metal vapor with the oxidizer produces molecular species having a population inversion therein. (auth)

24288 APPARATUS FOR UNIFORM PUMPING OF LASING MEDIA. Condit, W. C.; Eccles, S. F. (to U. S. Energy Research and Development Administration). US Patent 3,883,819. H01s3/09. 13 May 1975. Filed date 23 May 1974. 9p.

PAT-APPL-472,928.

Electron beam pumping of gaseous or liquid lasing media is carried out by means of electron pulses generated by an electron accelerator. Between the accelerator and the laser cavity, the electron pulse is subjected to a magnetic field to turn the electron pulse approximately through a quarter orbit, so that in essence the direction of pulse travel is changed from axial to lateral. This procedure then enables pumping of the laser cavity uniformly and simultaneously, or in any desired traveling wave mode, over the entire length of the laser cavity with relatively short, and highly intense, electron pulses. (auth)

24289 CONTINUOUSLY OPERATING Nd-YAG LASER. Wolinski, W.; Nowicki, M.; Niechoda, Z.; Cherka, M. (Politechnical Inst. of Technological Electronics, Warsaw). Elektronika (Warsaw).; 16: No. 6, 241-243(1975). (In Polish).

The parameters and measurement results of the continuously operating Nd-YAG laser with an output power 1.4 W, are described. Two 1 kW halogen pumping lamps were used. The influence of the optical resonator configuration and cooling water temperature on laser output power were investigated. The short— and long— time stability and output power fluctuations were measured. (auth)

24290 VOZNIKNOVENIE KVANTOVOI ELEKTRONIKI. (Development of Quantum Electronics). Dunskaia, I. M. Moscow; Izdatel'stvo Nauka (1974). 160p.

The historical development of quantum electronics is reviewed, starting from the basic concepts, representations, and ideas to the design and construction of the first maser and laser configurations. The problems (and their solutions) encountered in laser development are studied, and the contributions of various investigators to the development of molecular lasers, quantum paramagnetic amplifiers, and similar systems are noted. (IAA)

24291 VOLNOVYE I FLUKTUATSIONNYE PROTSESSY V LAZERAKH. (Wave and Fluctuation Processes in Lasers). Klimontovich, I. L. (ed.). Moscow; Izdatel'stvo Nauka (1974). 416p.

A semiclassical theory of wave and fluctuation processes occurring in gas lasers is developed. The theory is shown to be applicable to the analysis of complex problems that are not readily amenable to solution on the basis of laser quantum theory. Particular attention is given to gas ring lasers, and to the processes occurring in single-mode gas lasers and in multimode gas ring lasers. (IAA)

24292 EFFECT OF REFRACTIVE-INDEX NONLINEARITY ON THE OPTICAL QUALITY OF HIGH-POWER LASER BEAMS. Suydam, B. R. IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 6, 225-230(Jun 1975).

Both small-scale and large-scale partial self-focusing produce phase distortions which result in loss of optical quality of the beam. Both effects are studied and both can result in significant power loss. Incipient fine-scale self-focusing losses can be mitigated by spatial filtering. Nonlinear lensing, i.e., partial large-scale self-focusing, is more or less serious depending on the size of the target onto which the beam is to be focused. (auth)

24293 SCALING GENERALIZATIONS FOR A CO ELECTRIC LASER. Lacina, W. B.; McAllister, G. L. (Northrop Research and Technology Center, Hawthorne, CA). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 6, 235-241(Jun 1975).

Several scaling generalizations for a high-pressure CO electric-discharge laser (EDL) are presented and compared with experimental data from a pulsed e^--beam-stabilized device. It is shown that the transient evolution of the CO laser medium is mainly dependent only upon the total energy deposition per CO molecule as a function of time. Results of theoretical calculations for CO/Ar mixtures are presented which show that, for temperatures 100 to 300^{0}K, laser threshold occurs after E/p/sub CO/ approximately 0.5 – 1.0J/1/torr (CO) has been deposited, and that steady state is attained after E/p/sub CO/ approximately 1.7 – 2.6J/1/torr (CO) has been deposited. Experimental results for a variety of CO/Ar and CO/N_2 mixtures confirm these predictions for a range of excitation rates. These generalizations make it possible to predict the temporal power characteristics of a large class of both pulsed and flowing cw CO lasers without resort to extensive computer calculations. Characterization of the gain saturation as a function of total radiation intensity was also investigated. Results indicate that, after attainment of steady state, the CO EDL saturates with threshold level like a simple two-level system, with a scaled saturation intensity of I/sub sat xi/p/sub CO^2/ approximately 0.6 equals 6.4 W/cm^2/torr^2 (CO) over the range of temperatures from 60 to 300^{0}K (xi is the fraction of CO self-broadening to total broadening). (auth)

24294 EXPERIMENTS AND THEORY ON ENERGY EXTRACTION IN AN ATMOSPHERIC-PRESSURE CO_2 AMPLIFIER WITH 60 ns-1 mu s PULSES. Girard, G.; Farcy, J. C.; Michon, M.; Vincent, P. (Centre de Recherches de la Compagnie Generale d'Electricite, Marcoussis, France). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 6, 241-247(Jun 1975).

The energy extraction for 60-ns pulses were measured and compared with experimental and theoretical results. The theoretical curve is in agreement with the experimental results. The theoretical evolution of alpha, N_{001}/N/sub A/, N_{100}/N/sub A/, and T in an amplifying stage is plotted. Finally, the different energy extraction versus the pulse duration was compared. (auth)

24295 OPTICALLY PUMPED FAR-INFRARED LASER: RATE EQUATIONS AND DIAGNOSTIC EXPERIMENTS. Henningsen, J. O.; Jensen, H. G. (Univ., Copenhagen). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 6, 248-252(Jun 1975).

A four-level rate-equation model for an optically pumped far-infrared (FIR) laser is presented, and an expression is derived for the output power as a function of pump power and gas pressure. The theory is compared with measurements on the 570.5-mu m line of CH_3OH, pumped by a CO_2 laser. The width of the gain curve is measured and is shown to go below the Doppler width of the laser transition at low pressure. This indicates that the use of a monochromatic pump source leads to a velocity selective pumping process. (auth)

24296 NEAR SINGLE-LINE OPERATION OF A FREE-BURNING $CS_2/O_2/N_2O$ FLAME LASER WITH A NONDISPERSIVE OPTICAL CAVITY. Foster, K. D.; Kimbell, G. H.; Snelling, D. R. (Defence Research Establishment, Valcartier, Quebec). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 6, 253-258(Jun 1975).

The $CS_2/O_2/N_2O$ flame laser has been operated for the first

time under conditions in which the spectral output is nearly single line. This transition is the $P_{10-9}(17)$ of CO at 5.4265 mu m, the same transition which was observed to oscillate in single-line fashion by Hirose et al. in an electrically initiated CO chemical laser. It is suggested that the unique behavior of this line may be due to its close proximity to a P branch transition in an adjacent band, namely the $P_{9-8}(23)$ line, such that the gain profiles of the two lines overlap. Calculations suggest that at the conditions of these experiments, the separation of the line centers for this pair is about 0.3 A or less. The $P_{10-9}(17)$ transition was also found to be totally absent under certain conditions of high multiline power, particularly at low O_2 and N_2O flows. This may be due to absorption by a high-band R branch transition at 5.4266 mu m, namely the $R_{15-16}(32)$ line. (auth)

24297 NOISE CHARACTERISTICS OF STRIPE-GEOMETRY DOUBLE-HETEROSTRUCTURE JUNCTION LASERS OPERATING CONTINUOUSLY. I. Intensity Noise at Room Temperature. Paoli, T. L. (Bell Telephone Labs., Inc., Murray Hill, NJ). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 6, 276-283(Jun 1975).

Measurements of the noise fluctuations present in the output intensity from stripe-geometry double-heterostructure junction lasers operating continuously at room temperature are reported. In some but not all the lasers studied, the low-frequency (50-MHz) fluctuations exhibit the quieting expected of an amplitude-stabilized oscillator operating above threshold. The intensity noise in these lasers becomes shot noise limited at currents about 10 percent above threshold, even when many longitudinal modes are oscillating. Additional measurements demonstrate explicitly the effective elimination of the wave-interaction, or excess, noise during the transit of the threshold region. However, in other lasers which are nominally similar, only a partial reduction of the excess noise occurs above threshold, resulting in a noise level which can be more than ten times the shot-noise limit. In addition, all lasers studied showed no quieting at high frequencies (4GHz), in apparent contradiction to the behavior expected of a well-stabilized oscillator. (auth)

24298 EFFECTS OF FOCUSING ON THIRD-ORDER NONLINEAR PROCESSES IN ISOTROPIC MEDIA. Bjorklund, G. C. (Stanford Univ., CA). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 6, 287-296(Jun 1975).

A theoretical analysis of third-order nonlinear interactions of focused laser beams is performed for the processes $omega_1 + omega_2 + omega_3$ yields $omega_4$, $omega_1 + omega_2 - omega_3$ yields $omega_4$, and $omega_1 - omega_2 - omega_3$ yields $omega_4$. The total power and far-field beam profile of the generated radiation is related to the total powers of the fundamental beams, to the tightness and location of the focus, and to the value of the difference between the wave vectors of the generated radiation and driving polarization. The optimum degree of wave-vector mismatch as a function of tightness and location of focus is determined for each of the three processes. The process $omega_1 + omega_2 - omega_3$ yields $omega_4$ is found to be unique in that it is always optimized by focusing as tightly as possible. Experimental results, which verify the theory for the processes $omega_1 + omega_2 + omega_3$ yields $omega_4$ and $omega_1 + omega_2 - omega_3$ yields $omega_4$, are presented. (auth)

24299 EFFECTS OF NEAR-RESONANCE SELF-ABSORPTION ON CO LASER KINETIC MODELING. Lacina, W. B. (Northrop Research and Technology Center, Hawthorne, CA). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 6, 297-302(Jun 1975).

Resonance self-absorption from overlapping lines is an important pressure-dependent mechanism for theoretical analysis of a high-pressure CO laser. Although the effect on total optical output efficiency, kinetic heating rate, and transient time scales is small, predicted output spectral distributions can change significantly. Results of calculations are presented which show that output power is redistributed to higher vibrational bands with more unique P(J) characteristics. Previous analytical work on CO laser kinetics produced distributions that lay one or two U bands lower than what is observed, and was incapable of explaining anomalous spectra which often show certain transitions missing. Qualitative comparisons with experiment indicate that these effects occur at much lower pressures than theoretically predicted by this analysis. This suggests that further work will be required to correctly describe the mechanism of optical broadening in a CO laser medium. (auth)

24300 MECHANISM OF THE $N(^4S) + CS_2$ REACTION: N_2–CO_2 LASER PUMPING FROM THE PRODUCTS OF THE $N(^4S) + CS_2$ REACTION. McGee, T. J.; Powell, F. X. (Catholic Univ. of America, Washington, DC). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 6, 302-304(Jun 1975).

The reaction of N atoms with CS_2 has been studied and a mechanism for the reaction proposed. It has been demonstrated that the N + NS reaction produces vibrationally excited N_2. Evidence has been presented which indicates that the rate of the $N + CS_2$ reaction is substantially slower than first indicated. The analogous reaction N + OCS yields NS + CO has also been studied and a mechanism proposed. (auth)

24301 Nd:$LiNbO_3$ LASER. Kaminow, I. P.; Stulz, L. W. (Bell Telephone Labs., Holmdel, NJ). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 6, 306-308(Jun 1975).

Laser action at 1.0845 mu m is demonstrated in a neodymium-doped $LiNbO_3$ crystal pumped by 0.7525-mu m krypton laser, which happens to coincide with a Nd absorption line. Although $LiNbO_3$ is a good laser host, with good electrooptic and acoustooptic properties, laser damage limits its applicability at present unless one is willing to maintain the crystal at 165°C. (auth)

24302 TWO-ELECTRON LASER TRANSITION IN SN(I). Sutton, D. G.; Galvan, L.; Suchard, S. N. (Aerospace Corp., El Segundo, CA). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 6, 312(Jun 1975).

A new laser oscillation has been observed in a pulsed discharge of He and $SnCl_4$. This oscillation at 1.061 mu m corresponds to the $5s5p^3\ ^3D^0_1$ yields $5s^25p6p\ ^3P_2$ transition in Sn(I). (auth)

24303 STUDIES OF THE INVERSION AND LOWER LEVEL RELAXATION IN PULSED TE CO_2 DISCHARGES. Garside, B. K.; Reid, J.; Ballik, E. A. McMaster Univ., Hamilton, Ont.). IEEE (Inst. Electr. Electron Eng.) J. Quant. Electron.; QE-11: No. 6, 264-270(Jun 1975).

It has generally been supposed that the rise and fall times of the gain in pulsed CO_2 laser discharges reflect the effective lifetimes of the lower and upper laser levels. Consequently, the ratio of the upper to lower level populations N/sub u//N/sub l/ should change during the evolution of the gain, and should be a relatively large number at the gain peak. The problems associated with the determination of this ratio using conventional direct gain measurements are discussed, and a new in-cavity technique is described that has sufficient precision to determine the ratio N/sub u//N/sub l/ as a function of time. The results obtained unambiguously demonstrate that the lower laser level empties rapidly during the rise time of the gain. This conclusion is further reinforced by some measurements concerning the time variation of the gain in the hot band (01^11 yields 11^10). (auth)

24304 CORRUGATED LASER STRUCTURES. Katzir, A.; Yariv, A.; Yen, H. W. (California Inst. of Tech., Pasadena). J. Vac. Sci. Technol.; 12: No. 4, 865-868(1975).

From 2nd conference on structure/property relationships in thick films and bulk coatings; San Francisco, CA (10 Feb 1975).

GaAs–GaAlAs grown on a GaAs substrate. The need for cleaved end mirrors may be eliminated in these lasers by incorporating internal periodic corrugation which provide feedback. This distributed feedback relies on Bragg reflection from the periodic perturbation, and thus the lasing wavelength is directly proportional to the corrugation period. Such corrugated laser structures are compatible with the fabrication of monolithic optical circuits and seem to be most suitable as light sources for integrated optics. Corrugated structures were prepared by ion milling or chemical etching through a photoresist mask which was generated by the interference of two laser beams. Laser emission was observed from GaAs–GaAlAs double heterostructures with internal corrugation when pumped electrically at 77°K. Theoretical considerations indicate that such lasers should have a very low threshold current and a good wavelength selectivity. Further experimental work on these devices is now in progress. (auth)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstracts 24246, 24722, 24726, and 24729.

24305 (LA-6004-PR) SUPERCONDUCTING MAGNETIC ENERGY STORAGE PROJECT AT LASL. Progress Report, 1 October–31 December 1974. Hassenzahl, W. V. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-ENG-36. 9p. Dep. NTIS $4.00.

Details are reported on the design of a 100-MJ superconducting magnetic energy storage system. Superconducting wire similar to what may be used in the 100-MJ coil has been ordered and a small test coil has been designed to test the wire and the winding technique to be used on the 100-MJ coil. A dc-ac inverter has been fabricated and tested, and the performance is described. (auth)

24306 PORTABLE HELIUM DEWARS FOR USE WITH SUPERCONDUCTING MAGNETOMETERS. Zimmerman, J. E.; Siegwarth, J. D. (National Bureau of Standards, Boulder, CO). Cryogenics; 13: No. 3, 158-160(Mar 1973).

Simple helium dewars have been constructed using gas-cooled

radiation shields and multi-layer aluminized plastic insulation. They will retain one liter of liquid for up to 40 h. The shields may be made mostly non-conducting so the dewar can be used with ultrasensitive superconducting magnetometers. For most other applications thin sheet metal such as copper or aluminium is suitable for the shields. (auth)

24307 FLUX JUMPS IN COMPOSITE SUPERCONDUCTORS IN A TIME DEPENDENT MAGNETIC FIELD. Kwasnitza, K. (Brown Boveri and Co. Ltd., Zurich). Cryogenics; 13: No. 3, 169-174(Mar 1973).

Experimental investigations of the stability behaviour of NbTi filamentary superconducting composites in a time-varying external magnetic field are reported. The magnetization due to the induced interfilamentary screening currents shows flux jumps. The influence of this sort of flux jump on dH/dt and on the twist rate has been measured, together with the influence exerted by the presence of a thin high-resistivity CuNi sheath surrounding the filaments. (auth)

24308 SUPERCONDUCTING MAGNET WITH SADDLE-SHAPED WINDING. Sychev, V. V.; Zenkevich, V. B.; Al'tov, V. A. (Inst. of High Temperatures, Moscow). Cryogenics; 13: No. 3, 177-178(Mar 1973).

A superconducting saddle-shaped winding has been produced in which, by dispensing with fuel stabilization and by using laminated bands, a ratio of external diameter of winding to "cold" channel diameter of 2 is achieved. The ratio of weight of the combined superconducting wire to the weight of the strengthening and constructional components is >1 : 5. (TFD)

24309 JOSEPHSON JUNCTIONS WITH FINITE SEPARATION FROM A SUPERCONDUCTING GROUNDPLATE. Jutzi, W. (IBM Research Lab., Zurich). Cryogenics; 15: No. 5, 249-253(May 1975).

The gate characteristics of Josephson junctions are described as a function of its separation from a superconducting groundplate, of its length over Josephson penetration depth, and other geometrical parameters. The geometrical dependence is estimated with simple, slide-rule formulas. An equivalent circuit is derived to compute static and dynamic properties of miniaturized junctions for computer circuitry. (auth)

24310 TRANSFORMATION OF MILLIMETER WAVES IN POINT SUPERCONDUCTING CONTACTS USING NATURAL JOSEPHSON GENERATION. Avakyan, R. S.; Vystavkin, A. N.; Gubankov, V. N.; Shtykov, V. D. Radiotekh. Elektron.; 20: No. 1, 216-219(Jan 1975). (In Russian).

The possibility of using the Josephson effect in weakly connected superconductors was studied experimentally and theoretically for the parametric transformation of weak variable signals. The purpose of this work was to experimentally investigate the transformation below signals of millimeter waves in point superconductor contacts using natural Josephson generation as the pumping signal. On the basis of the measurement results, the fluctuation sensitivity was analyzed for such transformers and compared with theory. (JPRS)

24311 OPERATION OF JOSEPHSON CONVERTER IN HIGH-FREQUENCY MAGNETIC FIELD FLUCTUATIONS. Slabkii, L. I. Meas. Tech. (USSR) (Engl. Transl.); 17: No. 9, 1369-1370(Sep 1974).

Translated from Izmer. Tekh.; 17: No. 9, 42-43(Sep 1974).

As is known, the domain of application of Josephson interference magnetometer converters is limited mainly to low-frequency narrowband measuring schemes while the noise spectrum power, produced by external sources, is a maximum in the high-frequency domain. In this connection, the question of the influence of high-frequency fluctuations of the external magnetic field on the output signal of a two-barrier quantum Josephson interferometer is studied. (auth)

24312 CURRENT LEADS FOR A CRYOSTAT FOR SHORT-TERM USE. Buynov, Yu. L.; Shebalin, I. Yu. (Physics Inst., Moscow). Instrum. Exp. Tech.; 17: No. 6, 1769-1771(1974).

Translated from Prib. Tekh. Eksp.; No. 6, 181-183(1974).

Cryogenic leads of W and Mo have been examined, and it is found that such leads can perform short-term service while injecting much less heat into the cold zone than ones made of ordinary materials. (auth)

24313 LEADS OF CAPACITY UP TO 10 kA FOR SUPERCONDUCTING MAGNET SYSTEMS. Keilin, V. E.; Kovalev, I. A. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech.; 17: No. 6, 1766-1768(1974).

Translated from Prib. Tekh. Eksp.; No. 6, 178-180(1974).

Current leads are described for superconducting magnet systems. The current-carrying part of the leads consists of a rod with spiral fins. The outer tube of stainless steel directs the flow of He along the groove between the ribs. Two forms of lead have been constructed using brass and copper, each of length about 450 mm. The ratio of length to cross section l/S was about 8 cm^{-1} for the brass leads, while it was ~33 cm^{-1} for the copper ones. The He evaporation rate for the brass leads varies from 40 to 480 liters/min (at NTP) as the current goes from 0 to 7 kA; the corresponding figures for the copper leads are from 110 to 440 liters/min for currents from 0 to 7.35 kA. The leads have been used to supply superconducting magnets with currents up to 7.8 kA. (auth)

24314 TESTBED FOR LARGE SUPERCONDUCTING MAGNET SYSTEMS. Zotov, I. L.; Keilin, V. E.; Klimenko, E. Yu. (Atomic Energy Inst., Moscow). Instrum. Exp. Tech.; 17: No. 6, 1763-1765(1974).

Translated from Prib. Tekh. Eksp.; No. 6, 178-180(1974).

The testbed includes test cryostats, helium refrigerating liquifiers, helium storage vessels, a dc power supply providing up to 10 kA, and a diagnosis and protection system. (auth)

24315 APPLICATIONS OF CRYOGENIC TECHNOLOGY, Volume 5. Fifth Annual Conference of the Cryogenic Society of America, Chicago, Illinois, October 3–5, 1972. Carr, R. H. (ed.). Whitestone, NY; Scholium International, Inc. (1973). 349p. (CONF-721023–).

Separate abstracts have been prepared for the conference papers. (DOG)

For abstracts of individual papers see: 24258, 24259, 24316–24318, 24553, 24729, 24730, 24740, 25253, and 25260.

24316 SUPERCRITICAL HELIUM HEAT TRANSFER. Giarratano, P. J. (Inst. for Basic Standards, NBS, Boulder, CO). pp 52-89 of Applications of Cryogenic Technology. Vol. V. Carr, R. H. (ed.). Whitestone, NY; Scholium International, Inc. (1973).

From 5th annual conference of the Cryogenic Society of America; Chicago, Illinois, USA (3 Oct 1972). See CONF-721023-.

This paper reports part of the National Bureau of Standards Cryogenics Division's program to provide helium heat transfer information to designers of helium cooling systems. An experiment on supercritical helium heat transfer is described, and its results are compared with various standard and modified correlation expressions. Extensive appendices give tables of helium viscosity, thermal conductivity, and Prandtl numbers from 3 to 300°K. (auth)

24317 APPLICATIONS OF CRYOGENICS IN ELECTRON MICROSCOPY. Fernandez-Moran, H. (Univ. of Chicago). pp 153-181 of Applications of Cryogenic Technology. Vol. V. Carr, R. H. (ed.). Whitestone, NY; Scholium International, Inc. (1973).

From 5th annual conference of the Cryogenic Society of America; Chicago, Illinois, USA (3 Oct 1972). See CONF-721023-.

Results of earlier work with superconducting lenses (objective lens excited with 27,220 ampere-turns) indicated some unique advantages inherent in systematic application of this approach in high resolution electron microscopy. Operating in the persistent current mode made possible resolutions of 10 to 20 A during longer exposure times at lower beam intensities, thus reducing specimen radiation damage. With the first prototype of a cryo-electron microscope system (i.e., large-scale, 20 W capacity, Collins closed-cycle superfluid helium refrigerator with 36-ft transfer lines and novel heat exchanger integrated with a modified 200 kV electron microscope), significantly reduced radiation damage, contamination and thermal noise are available in prolonged vibration-free examination of specimens at 1.8 to 4.2°K. Simultaneously, the system provides high penetration power, ultra-high vacuums, decreased spherical and chromatic lens aberrations, and enhanced image contrast. Specially-adapted vacuum-tight microchambers have been used in studies of ice-crystal structure, wet membranes and new types of organometallic superconducting compounds. Consistent resolutions of 8 to 16 A are achieved, compared with corresponding low temperature resolutions of about 50 A one year ago. Descriptions of these instrumental developments are given together with results of their applications and implications in specific research areas, particularly membrane ultrastructure, cryobiology, microelectronics and general superconducting work. (auth)

24318 COMMERCIAL USES OF SUPERCONDUCTIVITY: PRESENT AND FUTURE. Gregory, W. D. (Georgetown Univ., Washington, DC); Mathews, W. N. Jr.; Ladd, R. D.; Krieger, D. A. pp 193-204 of Applications of Cryogenic Technology. Vol. V. Carr, R. H. (ed.). Whitestone, NY; Scholium International, Inc. (1973).

From 5th annual conference of the Cryogenic Society of America; Chicago, Illinois, USA (3 Oct 1972). See CONF-721023-.

Most uses of superconductivity fall into two categories: the

very large (e.g., power transmission; magnets for MHD generators, fusion reactors, levitated trains) and the very small (e.g., quantized flux measurement of weak magnetic fields). A modest precommercial market now exists in both areas, but development of a true commercial market for superconductivity will depend on social, economic, and political factors as well as on technical feasibility. (auth)

Heat Transfer and Fluid Flow

Refer also to abstract 25262.

24319 (UCRL-50028-75-1, pp 9-12) CODE DEVELOPMENT GROUP. Edwards, L. L. 1975.

In H-Division quarterly report, January-March 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

The mission of H-Division's Code Development Group is the development of time-dependent, compressible-fluid-mechanics programs. The motivation in each case is related to developing codes (based on either known or new methods) that are aimed at solving several general classes of fluid-flow problems. Progress is reported on the development of TEULER, CEL-HEMP, CHAMP, LEEK, and BLIP codes. (TFD)

Materials Testing

Refer also to abstract 24452.

24320 (AEC-tr-7314, pp 42-51) ANALYTICAL DETERMINATION OF THE OPTIMAL PARAMETERS OF SCREEN-CONVERTERS FOR NEUTRON RADIOGRAPHY. Tyufyakov, N. D.; Shtan, A. S.; Yaskevich, V. S. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Since the photographic sensitivity of x-ray films to neutrons is low and x-rays are always present in the beam, it is necessary to increase the sensitivity of the films to neutrons in order to obtain a qualitative radiograph. One of the ways for such an increase involves the use of screens which convert the neutrons into other forms of radiation to which the films are more sensitive. The physical basis of this conversion is the interaction of the neutrons with the atomic nuclei of the screen material which is accompanied by secondary radiation. An analytical method for determining the optimal parameters of the screens is developed. (TFD)

24321 (AEC-tr-7314, pp 51-54) EFFECT OF THE DIMENSIONS OF THE γ-RADIATION SOURCE ON THE TRANSILLUMINATION TIME IN RADIOGRAPHIC CONTROL. Elisyutin, G. P.; Tyufyakov, N. D. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The possibility of decreasing the exposure time in gamma radiography by increasing the dimension of the radioactive source is considered. (TFD)

24322 (AEC-tr-7314, pp 209-217) EXTENDED SOURCE OF γ-RADIATION FOR RADIOGRAPHY. Karavaev, S. P.; Sul'kin, A. G.; Firstov, V. G.; Yakshin, V. V. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The use of extended sources based on ^{133}Ba with focal distances less than 10 mm in the control of welded joints of pipes, whose dimensions are comparable with the dimensions of the active part of the sources, ensures a higher sensitivity and control efficiency than in the case where point sources are applied. (TFD)

24323 (AEC-tr-7314, pp 354-357) OPTIMUM OPERATION TIME OF A RADIOISOTOPE RADIATION SOURCE IN FLAW DETECTION. Akopov, V. S.; Sul'kin, A. G.; Komarova, Yu. P.; Borisov, A. E. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

A method is developed for determining the optimum time to renew a gamma source in a radiographic flaw detector. Such factors as overhead, wages, cost of source, and work required to change source are considered. (TFD)

24324 THERMO-PHYSICAL ANALYSIS OF DEEP-COOLING SYSTEMS FOR OBJECTS STUDIED IN THE ZONE OF REACTOR RADIATION. Vadachkoriya, L. A. pp 98-122 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

Several versions of the subject cooling equipment are described, with diagrams, equations, and discussions—equipment using a liquid coolant, that using a gaseous coolant, equipment with natural or forced circulation of the coolant, and combinations of the different schemes. The various schemes presented are compared, giving the advantages and disadvantages of each. (TTT)

Nuclear Explosions

Refer also to abstract 24267.

24325 (JAB-99-115) EFFECTS PREDICTION GUIDELINES FOR STRUCTURES SUBJECTED TO GROUND MOTION. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). Jul 1975. Contract AT(26-1)-99. 389p. Dep. NTIS $10.60.

Part of the planning for an underground nuclear explosion (UNE) is determining the effects of expected ground motion on exposed structures. Because of the many types of structures and the wide variation in ground motion intensity typically encountered, no single prediction method is both adequate and feasible for a complete evaluation. Furthermore, the nature and variability of ground motion and structure damage prescribe effects predictions that are made probabilistically. Initially, prediction for a UNE involves a preliminary assessment of damage to establish overall project feasibility. Subsequent efforts require more detailed damage evaluations, based on structure inventories and analyses of specific structures, so that safety problems can be identified and safety and remedial measures can be recommended. To cover this broad range of effects prediction needs for a typical UNE project, three distinct but interrelated methods have been developed and are described. First, the fundamental practical and theoretical aspects of predicting the effects of dynamic ground motion on structures are summarized. Next, experimentally derived and theoretically determined observations of the behavior of typical structures subjected to ground motion are presented. Then, based on these fundamental considerations and on the observed behavior of structures, the formulation of the three effects prediction procedures is described, along with guidelines regarding their applicability. Example damage predictions for hypothetical UNEs demonstrate these procedures. To aid in identifying the vibration properties of complex structures, one chapter discusses alternatives in vibration testing, instrumentation, and data analysis. Finally, operational guidelines regarding data acquisition procedures, safety criteria, and remedial measures involved in conducting structure effects evaluations are discussed. (auth)

24326 (UCRL-50028-75-1, pp 35-37) SPECIAL PROJECTS GROUP. Wilkins, M. L.; Henry, C. R. 1975.

In H-Division quarterly report, January-March, 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Work on new projects or special problems is discussed. Projects discussed include nonlinear heat Eulerian code for the STAR 100 computer, studies in fracture mechanics, and computation of surface and subsurface explosions. (RCK)

24327 CABLE CONNECTOR. Barlow, T. M.; Ruffner, D. J. (to U. S. Energy Research and Development Administration). US Patent 3,877,775. H01r17/04; H01r3/00. 15 Apr 1975. Filed Date 27 Aug 1973. 7p.

PAT-APPL-391,086.

A connector for electric cables subjected to high-pressure environments and for making electrical connections across high-pressure, low-pressure interfaces is described. The connector includes a reservoir of dielectric liquid which fills space between the cable and the inner wall of the connector body. A rubber boot fitted over the connector body contains the reservoir and transmits the environmental pressure to the liquid thereby providing hydrostatic pressure in opposition to the environmental pressure transmitted into the connector through the cable components. The connector is applicable to electrical communication systems for underground nuclear explosions. (auth)

24328 NUCLEAR PROLIFERATION IN THE THIRD WORLD: SOME ASPECTS THE WEST NEGLECTS. Kapur, A. (Univ. of Waterloo, Ont.). Sci. Forum; 8: No. 3, 22-24(Jun 1975).

The author contends that the non-proliferation treaty is not clear in distinguishing between peaceful and non-peaceful nuclear explosions. Those countries which signed the non-proliferation treaty obviously recognize the desirability of peaceful nuclear explosions if these are safeguarded. There is some disagreement, however, about whether India's nuclear test, for example, was peaceful or non-peaceful. According to the logic of the non-proliferation treaty, India's first test must necessarily be viewed as the first step towards a weapons program. Clearly, countries exporting nuclear technology will have to make a policy choice if they seek to slow horizontal proliferation. (CA)

24329 NUCLEAR EXPLOSIVES AND ITS APPLICATION IN MINING. Khoda, R. (Voltas Limited, Maharashtra, India). Indian Mining Eng. J.; 14: No. 3, 23-26(Mar 1975).

Factors to be considered in evaluating the use of underground nuclear explosions for mining are briefly reviewed and include: size of fracture zone produced by an explosive for various emplacement conditions, safety, cost, and geologic and hydrologic conditions required for safe and economic use. It is concluded that such mining uses are not practical in India at present but that studies of nuclear explosions for underground oil retorting should be encouraged. (LCL)

Protective Structures and Equipment

24330 (TID-26649) DEVELOPMENT OF NEW FLUORIDE RESISTANT HEPA FILTER MEDIUM FINAL REPORT. Belvin, W. L.; Krimmel, M. A.; Schwalbe, H. C.; Gleaton, E. N. (Herty Foundation, Savannah, Ga. (USA)). 19 Aug 1975. Contract AT(38-1)-411. 69p. Dep. NTIS $6.50.

All objectives of the program were accomplished. A satisfactory filter medium was developed whose corrosion resistance was demonstrated in both laboratory tests and in full scale engineering tests of filters made with the medium. Manufacturability was demonstrated by producing several rolls on a 31-in. Foudrinier and 27-in. Rotoformer, and by preparing a detailed description of the procedure. This procedure was reviewed by three paper manufacturers, Bowaters, Inc., Knowlton Brothers Inc., and Holingsworth and Vose Co.; Holingsworth and Vose was the only one with experience in the production of high efficiency air filter papers. The concensus of these reviewers was that, although the procedure described is complicated, it can serve as the basis for developing full-scale commercial procedures for the manufacture of this material. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

24331 (KH-R-30) HYDRAULIC MODELING OF THERMAL OUTFALL DIFFUSERS FOR THE SAN ONOFRE NUCLEAR POWER PLANT. Koh, R. C. Y.; Brooks, N. H.; List, E. J.; Wolanski, E. J. (California Inst. of Tech., Pasadena (USA)). Jan 1974. 180p.

Hydraulic model tests were performed for the San Onofre Nuclear Generating Station near San Clemente, California. Model investigations included the multiple port discharges for the proposed Units 2 and 3; the existing submerged single outlet discharge from Unit 1; the discharge of heated water from intakes of Units 2 and 3 during heat treatment; and hydraulic characteristics of discharge ports. The diffusion structure for each of the proposed 2 new units was designed to be 2,500-ft-long, aligned perpendicular to shore. The diffuser for Unit 3 will extend from 3,500 to 6,000 ft from shore, and that for Unit 2, from 6,000 to 8,500 ft from shore. Each diffuser will have 63 discharge nozzles aimed offshore (+-25^0 from the pipe axis, 20^0 above horizontal). The momentum of the discharge produces an offshore drift of the diluted warmwater plume. The maximum temperature rise on the surface caused by the discharge decreases with increasing longshore current speed, and the discharge momentum from the jets was effective in preventing significant reentrainment in the event of reversing or low currents. The prototype outfall operation is designed to meet the California thermal discharge requirements. (Pollut. Abstr.)

24332 (LA-UR-75-1473) WASTE MANAGEMENT AND SAFETY CONSIDERATIONS FOR FUTURE LASL D AND D PROJECTS. Valentine, A. M.; Warren, J. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1975. Contract W-7405-ENG-36. 21p. (CONF-750822-5). Dep. NTIS $4.25.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

Currently excess contaminated facilities at the Los Alamos Scientific Laboratory are described along with associated Decontamination and Decommissioning waste management and safety considerations. Waste management and safety considerations are also briefly described for the removal and disposal of plutonium contaminated gloveboxes and equipment items in the LASL plutonium facility since the facility will be decontaminated when current operations are transferred to a new facility and for both past and future upgrading of the exhaust air filter system in a chemistry metallurgy research facility. (auth)

24333 FIELD OBSERVATIONS OF THE DYNAMICS OF HEATED DISCHARGE JETS. Frigo, A. A.; Zivi, S. M.; King, R. F.; Levinson, E. D. (Argonne National Lab., IL). Contract W-31-109-ENG-38. pp 412-424 of Proceedings of the 17th Conference on Great Lakes Research. Ann Arbor, MI; International Association of Great Lakes Research (1974).

From 17th conference on Great Lakes Research; Ann Arbor, MI (1974).

Field studies of the dynamics of heated discharge jets were conducted during 1973 at the Point Beach, J. H. Campbell, and Waukegan Power Plants located on Lake Michigan. Measurements of temperature and velocity were made from a small boat anchored near the end of the power plant's surface discharge canals. An aluminum bar equipped with fast-response thermistors was lowered over the side of the boat so that water temperatures were sensed simultaneously from the water surface to a depth of three meters. A full set of temperatures was sampled every two seconds. Simultaneously, the local water velocity was measured and recorded at similar time intervals. Coherent temperature oscillations were observed with several degree (^{0}C) magnitudes and with periods ranging from 2 min to 20 min, depending on the plant. Oscillations in velocity were observed at the corresponding frequencies, and were coherent with the temperatures. (auth)

Minerals and Ores

Refer also to abstract 24165.

24334 (BM-RI-8036) POLYMERIC MATERIALS FOR SEALING RADON GAS INTO THE WALLS OF URANIUM MINES. Franklin, J. C.; Nuzum, L. T.; Hill, A. L. (Bureau of Mines, Spokane, Wash. (USA). Spokane Mining Research Center; New Mexico Environmental Improvement Agency, Santa Fe (USA)). 1975. 29p. Dept. of Interior, Washington, DC.

The Bureau of Mines conducted extensive laboratory and limited field tests to determine whether a polymeric material could effectively reduce the emanation rate of radon gas from uranium ore. In the laboratory 46 different single-coat materials and 14 two-coat applications were tested. The laboratory tests showed that up to 100 percent of the radon gas could be sealed into the rock. Materials tested in the laboratory were polyesters, furan resins, epoxies, latices, and totally inorganic coatings. From the laboratory work six different materials were selected for field testing. The first test was single-coat materials in five static chambers; the second test used two-coat applications in an open chamber. Both tests were conducted in the Dakota mine at Grants, N. Mex. During the second test, the emanation rate of radon gas was reduced up to 62 percent. (auth)

24335 (INIS-mf-1716, pp 81-97) URANIUM AND THORIUM: FUTURE ENERGY SOURCES. Folinsbee, R. E.; Leech, A. P. [nd].

From symposium on energy resources; Ottawa, Ontario, Canada (15 Oct 1973).

In symposium on energy resources, October 15-17, 1973. (Royal Society of Canada, Ottawa, Ontario).

World uranium demand and reserves are forecast as far as 1980 or 2000, taking into account the incentive to mine lower quality ores as uranium prices rise. The geological potential for uranium mineralization is discussed for selected areas and the geological characteristics of existing ore bodies are described. Thorium is not treated in any detail. (INIS)

24336 (UCID-16883) LLL URANIUM HYDROGEOCHEMICAL SURVEY. Project Highlights for July 1975. Holder, B. E. (Comp.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Aug 1975. Contract W-7405-Eng-48. 7p. Dep. NTIS $4.00.

Status of the LLL hydrogeochemical survey of Winnemucca Lake, Smoke Creek Desert, Cave Valley, and Roach Lake basins in Nevada is reported. A reconnaissance sampling of Winnemucca Lake was made to determine its accessibility by four-wheel drive vehicles and to test hand augering as a means of collecting samples. About 100 sediment samples were taken from alluvial fans and dry stream channels of Walker Basin. Preliminary survey analyses were performed on 24 samples from Walker River and its tributaries. (LK)

24337 URANIUM RESOURCES IN THE UNITED STATES. Grenon, Michel. 26: No. 272, 636-643(Apr 1975). (In French).

The United States is certainly the country which is the most concerned by a better evaluation of uranium resources. This is so because of the importance of the American nuclear program and because of a certain number of doubts in their uranium supply. This is probably why studies concerning American uranium resources have been very frequent in recent months. Although, most of these studies are not yet finished it is perhaps possible to draw a few conclusions in order to better see the framework of this important uranium resources problem. This is what this article attempts, using among other studies, the one carried-out for the National Science Foundation which is among the most complete, especially concerning the complete range of resources. (FR)

Radioactive Effluents

Refer also to abstract 25235.

24338 (CONF-750662-3) DOSE ESTIMATION AND PREDICTION OF RADIATION EFFECTS ON AQUATIC BIOTA RESULTING FROM RADIOACTIVE RELEASES FROM THE NUCLEAR FUEL CYCLE. Blaylock, B. G.; Witherspoon, J. P. (Oak Ridge National Lab., Tenn. (USA)). 1975. 21p. Dep. NTIS $4.25.

From symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

Aquatic organisms are exposed to radionuclides released to the environment during various steps of the nuclear fuel cycle. Routine releases from these processes are limited in compliance with technical specifications and requirements of federal regulations. These regulations reflect I.C.R.P. recommendations which are designed to provide an environment considered safe for man. It is generally accepted that aquatic organisms will not receive damaging external radiation doses in such environments; however, because of possible bioaccumulation of radionuclides there is concern that aquatic organisms might be adversely affected by internal doses. The objectives of this paper are: to estimate the radiation dose received by aquatic biota from the different processes and determine the major dose-contributing radionuclides, and to assess the impact of estimated doses on

aquatic biota. Dose estimates are made by using radionuclide concentration measured in the liquid effluents of representative facilities. This evaluation indicates the potential for the greatest radiation dose to aquatic biota from the nuclear fuel supply facilities (i.e., uranium mining and milling). The effects of chronic low-level radiation on aquatic organisms are discussed from somatic and genetic viewpoints. Based on the body of radiobiological evidence accumulated up to the present time, no significant deleterious effects are predicted for populations of aquatic organisms exposed to the estimated dose rates resulting from routine releases from conversion, enrichment, fabrication, reactors and reprocessing facilities. At the doses estimated for milling and mining operations it would be difficult to detect radiation effects on aquatic populations; however, the significance of such radiation exposures to aquatic populations cannot be fully evaluated without further research on effects of chronic low-level radiation. (auth)

Radioactivity Monitoring and Transport

Refer also to abstract 24165.

24339 (ORNL-EIS-75-21-6) ENVIRONMENTAL ASPECTS OF THE TRANSURANCIS. A Selected, Annotated Bibliography. Martin, F. M.; Faust, R. A.; Sanders, C. T. (comps.). (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. 196p. (NVO-AEIC-75-2). Dep. NTIS $13.00.

This bibliography of 470 references is from the computer file built to provide information support to the Nevada Applied Ecology Group (NAEG) of ERDA's Nevada Operations Office. The general scope is environmental aspects of uranium and the transuranic elements, with emphasis on plutonium. Biological aspects of the transuranics is highlighted in this bibliography. In addition, supporting materials involving basic ecology studies, ecology of the Nevada Test Site, and reviews on other radionuclides are entered at the request of the NAEG. Significant numeric data is shown in tabular display or is noted for reference to the original document. The references are arranged by subject category with first authors arranged alphabetically within the category. Indexes are given for author, keywords, geographic location, permuted title, taxons, and publication description. (auth)

24340 NATURAL RADIOACTIVITY IN ILMENITE AGGREGATES. Gesell, T. F.; Prichard, H. M. (Univ. of Texas, Houston). Health Phys.; 29: No. 2, 354(Aug 1975).

The results of measurements made of the natural radioactivity of the high density aggregate ilmenite are given. Concentrations of potassium, uranium, and thorium measured in fine and medium ilmenite compared with those found in rock and soil, are tabulated. It is shown that these concentrations are quite low in comparison to normal crustal materials. Ilmenite should probably be considered by those who are constructing low background facilities. (UK)

Atmosphere

Refer also to abstracts 24221–24223, 24439, 24444, 25423, 25431, and 25435.

24341 DBA LEAKAGE. Haekkinen, H. H. Sahko; 47: No. 12, 519-524(Dec 1974).

The thermal powers of Finnish nuclear power stations in the 1980s will probably be mainly in the region of 3,000 MW. There are also plans for locating as many as 8 units of approximately this size in the same area, such as at Kopparnäs and Oikiluoto. As the calculations here show, the risk to the environment of just one power station unit may be great. This is indicated by the large amount of radioactive iodine, as much as 300,000 Ci-I-131, leaking into the environment in the case of a serious accident. A leak of this enormity could have a considerable effect on planning of the entire power station project. The risk can be reduced by building a more tightly sealed reactor containment than is assumed here and by equipping it with several shells. (auth)

24342 FALLOUT FROM THE 15TH CHINESE NUCLEAR TEST. Nakahara, H. (Niigata Univ., Japan); Sotobayashi, T.; Nitho, O.; Suzuki, T.; Koyama, S.; Tonouchi, S. Health Phys.; 29: No. 2, 291-300(Aug 1975).

Fallout particles and radioactive rains from the 15th Chinese nuclear test were studied by an optical microscope, γ-ray spectrometry, and an electron microprobe x-ray analyzer. The particles were found to be very brittle and of irregular shape. Gamma-ray spectrometry showed that the fractionation behavior of nuclides was extraordinary when compared with those observed for fallout particles in the past. The ^{105}Rh γ rays could be observed unexpectedly. Fractionation between the A = 103 and A = 105 mass chains is discussed in terms of the particle formation time and the temperature. The ^{239}Np/^{237}U ratios varied from 0.8 to 4.0 and an attempt was made to correlate the ratios with the type of bomb. Study of particle host materials showed that the hosts were composed of earth materials from the bomb testing site and small amounts of iron. It is noteworthy that sulphur and bromine were also found among the host materials. (auth)

Soil

Refer also to abstract 25424.

Water

24343 (CONF-750662-1) BEHAVIOR OF PLUTONIUM AND OTHER LONG-LIVED RADIONUCLIDES IN LAKE MICHIGAN. II. Patterns of Deposition in the Sediments. Edgington, D. N.; Robbins, J. A. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-eng-38. 18p. (SM-198/40). Dep. NTIS $4.00.

From symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

At present eight operating nuclear power reactors are situated along the shores of Lake Michigan. Since their releases of radioactivity have been much less than that entering the lake from stratospheric fallout, ^{239,240}Pu and ^{137}Cs from the latter source have been measured in order to attempt to predict the depositional patterns of long-lived radionuclides in the lake. Ninety-seven percent of the ^{239,240}Pu and ninety-five percent of the ^{137}Cs that has entered the lake by wet and dry deposition of atmospheric fallout now reside in the sediments. The vertical distribution of ^{137}Cs has been measured in 60 sediment cores, and ^{239,240}Pu in 14 cores taken from all over the lake. The sampling locations were chosen to be representative of the various types of sedimentation, i.e., areas with high sedimentation associated with river inputs, offshore locations where organic-rich, very fine-grained material is settling out, and areas of low sedimentation where erosion may be occurring. Results of the studies are discussed. (auth)

24344 (CONF-750662-2) BEHAVIOR OF PLUTONIUM AND OTHER LONG-LIVED RADIONUCLIDES IN LAKE MICHIGAN. I. Biological Transport, Seasonal Cycling, and Residence Times in the Water Column. Wahlgren, M. A.; Marshall, J. S. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-eng-38. 21p. (SM-198/39). Dep. NTIS $4.25.

From symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

Eight operating nuclear reactors are situated on the shores of Lake Michigan, but their releases of radioactivity have been much less than that entering the lake from stratospheric fallout. Measurements of ^{239,240}Pu, ^{241}Am, and ^{137}Cs from the latter source have been made in order to study biological transport, seasonal cycling, and residence times of long-lived radionuclides in the lake. The apparent turnover times for the residual fallout ^{239,240}Pu and ^{137}Cs, which are present as nonfilterable, ionic forms, are about 3 to 4 y. Resuspension may be occurring at a low rate, probably through the feeding activities of benthic organisms. Transport by settling of phytodetritus and zooplankton fecal pellets is postulated to be the cause of the rapid decline of the concentration of ^{239,240}Pu in surface waters observed during summer thermal stratification of the lake, while the concentration of ^{137}Cs remained almost constant. Concentration factors for fallout ^{239,240}Pu, ^{137}Cs, and ^{90}Sr at various trophic levels in the food chain in Lake Michigan have been measured. Analyses of biological samples taken at various distances from the Big Rock Point Nuclear Power Plant and of plant waste discharge show that any plutonium possibly released from the recycle plutonium test fuel is too low to be detectable in the presence of fallout plutonium. Measurements of ^{239,240}Pu, ^{137}Cs, and ^{90}Sr on a comparison set of surface water and net plankton samples from all five Great Lakes indicate generally consistent behavior patterns in these lakes. (auth)

24345 (ORO-3852-20) GEOCHEMICAL BEHAVIOR OF URANIUM AND THORIUM SERIES NUCLIDES. Annual Progress Report, 1974–1975. Sackett, W. M. (Texas Agricultural and Mechanical Univ., College Station (USA)). 1975. 12p. (CONF-750503-25). Dep. NTIS $4.00.

From 4th national symposium on radioecology; Corvallis, Oregon, USA (12 May 1975).

Data are reported from measurements of the content of ^{228}Ra and ^{226}Ra in samples of ground water collected in Texas and samples of seawater from the Gulf of Mexico off the Texas coast. Results of measurements of the content of ^{226}Ra, ^{238}U, and total U in samples of livestock feed supplements and the content of ^{226}Ra and U in phosphate fertilizers from plants in Florida and North Carolina are also reported. (CH)

24346 RESEARCHES OF THE INSTITUTE OF BIOLOGY OF SOUTHERN SEAS, ACADEMY OF SCIENCES OF THE UKRAINIAN SSR DURING THE 70TH CRUISE OF THE RESEARCH SHIP AKADEMIK A. Kovalevskii. Kulebakina, L. G. pp 4-14 of Radiokhemo-Ekologicheskie Issledovaniya v Sredizemnom More. Kovalevskii, A. Kiev; Naukova Dumka (1975). (In Russian).

The concentration of strontium-90 in the Black Sea was 0.60 to 0.74 pC/l (May, 1972) in the Mediterranean Sea it was 0.53 to 1.20 pC/l (May-July, 1972). It is slightly higher than those in the previous years. The highest concentrations of strontium-90 among the organisms are registered for the red calcium algae and clams Pectinidae (the concentration factors and equal to 100 to 700). Further radioecological researches in the Mediterranean areas are necessary. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 24338 and 24529.

24347 (EMSL-LV-539-1) ^{131}I LEVELS IN COW'S MILK FOLLOWING INGESTION OF CONTAMINATED ALFALFA OR SUDAN GRASS. Black, S. C.; Stanley, R. E.; Barth, D. S. (Environmental Protection Agency, Las Vegas, Nev. (USA). Environmental Monitoring and Support Lab.). Aug 1975. Contract AT(26-1)-539. 22p. Dep. NTIS $4.00.

A dry aerosol, consisting of submicrometer diatomaceous earth particles tagged with ^{131}I, was released over two different types of growing forage (alfalfa and Sudan grass) at the Experimental Dairy Farm on the Nevada Test Site. Following deposition of the aerosol, the two forage types were chopped and fed to different groups of lactating dairy cows. The dual objectives of the study were to evaluate the relationship of ^{131}I secretion in milk to the ingestion of different types of contaminated forage and to obtain a further indication of the possible influence on milk radioiodine levels of changing the particle size of the contaminant. The ratios of the peak activity concentrations measured in the milk to the peak activity concentrations in the forage were computed to be 0.0145 for the cows fed contaminated alfalfa and 0.0082 for those fed contaminated Sudan grass. Comparison of the results from this study with those from earlier studies indicates the major effect on activity levels in the milk can be related to forage type. Ingestion of Sudan grass by the cow reduces the transfer of radioiodine to milk by one half compared to ingestion of alfalfa. (auth)

24348 ^{45}Ca, ^{54}Mn, ^{57}Co, AND ^{90}Sr CONCENTRATION AND FIXATION BY DIFFERENT ALGAL POLYSACCHARIDES. Ryndina, D. D. pp 75-82 of Radiokhemo-Ekologicheskie Issledovaniya v Sredizemnom More. Kovalevskii, A. Kiev; Naukova Dumka (1975). (In Russian)

Sorption properties of some polysaccharides of brown and red algae in relation to ^{45}Ca, ^{54}Mn, ^{57}Co, and ^{90}Sr were studied. Algulose obtained from fresh alga Cystoseira barbata was found to concentrate more intensively and to fix weaker isotopes of a number of biogenic elements (^{54}Mn, ^{57}Co) as compared with samples obtained from decomposing organisms. The barium complex of fucoidan may be a ^{54}Mn and ^{57}Co concentrator in C. barbata and C. corniculata. Due to ^{57}Co high concentrator factors and strong fixation by some species of polysaccharides, possibility of their concentration in marine sublittoraly with algae decay and detritus formation should be taken into account. (auth)

24349 ROLE OF HIGH MOLECULAR COMPOUNDS OF BROWN ALGAE IN ^{90}Sr EXTRACTION FROM SEAWATER. Ryndina, D. D. pp 66-75 of Radiokhemo-Ekologicheskie Issledovaniya v Sredizemnom More. Kovalevskii, A. Kiev; Naukova Dumka (1975). (In Russian)

The paper deals with experimental results of researches on the role of brown algae Cystoseira barbata polysaccharides (alginic acids, fucoidan, and algulose) in ^{90}Sr extraction from seawater. Fucoidan removal from Cystoseira barbata was found to decrease the capacity of the latter for ^{90}Sr concentration from the environment. Fucoidan in Cystoseira may play the role not only as a ^{90}Sr concentrator, but also as a stimulator for its processes of fixation by alginic acids. In the process of the Cystoseira decomposition, pH of its intracellular solutions was observed to increase from 5.87 to 7.4. A decrease in the ^{90}Sr c.f. values in Cystoseira barbata during the decomposition and detritus formation is due to a change in alginic acids' sorption properties with the change in pH of intracellular solutions. (auth)

24350 STUDY OF ACCUMULATION OF SOME RADIONUCLIDES BY SUSPENDED MATTER AND LIVING ORGANISMS. Kulebakina, L. G.; Lazorenko, G. E. pp 43-52 of Radiokhemo-ekologicheskie Issledovaniya v Sredizemnom More. Kovalevskii, A. Kiev; Naukova Dumka (1975). (In Russian)

About 70 to 100% of ^{55}Fe and 40% of ^{54}Mn in sea water is in the solid phase, but ^{57}Co practically is not absorbed on the particle. The highest concentration factors are obtained for the particles 1.2 to 2.5 m and 0.3 to 0.5 μm in size: 2.10^3 for ^{55}Fe, 5.10^2 to 3.10^3 for ^{54}Mn, and 100 to 200 for ^{57}Co. Concentration factors of these radionuclides for the particles 0.1 – 0.3 μm in size are equal to 10 to 200 units. The accumulation mechanisms of algae are different for Sr, Co, and Fe radionuclides which are in different physicochemical state in sea water. The concentration of ^{90}Sr depends on salinity of water and mechanism of ^{90}Sr metabolism is changed in algae. The concentration of ^{57}Co by algae in sea water of lower salinity is suppressed with time, but that of ^{55}Fe does not depend on salinity. (auth)

24351 ION EXCHANGE PROPERTIES OF ALGINATES OF DIFFERENT ORIGIN IN SEA WATER. Lazorenko, G. E. pp 52-60 of Radiokhemo-Ekologicheskie Issledovaniya v Sredizemnom More. Kovalevskii, A. Kiev; Naukova Dumka (1975). (In Russian)

The present paper deals with sorption properties of alginates of differ origin in relation to radionuclides ^{54}Mn, ^{55}Fe, ^{57}Co, and ^{90}Sr. The Ca alginate obtained from the Mediterranean Sea brown alga Cystoseira corniculata was found to accumulate ^{54}Mn, ^{55}Fe, ^{57}Co, and ^{90}Sr to the concentration factors (c.f.) 122, 663, 137, 1510, and 519 units. The same radionuclides c.f. for the Ca alginate extracted from the Black Sea brown alga Cystoseira barbata are equal to 101, 245, 63, and 182 respectively. Alginic acid obtained from the Na alginate at the Arkhangelsk algal enterprises sorbs radionuclides of Mn, Fe, Co, and Sr only in insignificant quantity. Their c.f. are 5, 77, 11, and 14. Difference in the sorption properties of alginates of different origin in sea water might be due to their different chemical composition. (auth)

24352 ACCUMULATION OF ^{57}Co AND ^{55}Fe BY SOME ZOOPLANKTON ORGANISMS OF THE MEDITERRANEAN SEA. Benzhitskii, A. G.; Sazhina, L. I. pp 36-40 of Radiokhemo-Ekologicheskie Issledovaniya v Sredizemnom More. Kovalevskii, A. Kiev; Naukova Dumka (1975). (In Russian)

Among the studied zooplankton of the Mediterranean Sea, the Mediterranean Sea, the Copepoda representatives serve as bioindicators of Fe and Co radioisotopes. Their whole vital cycle occurs in the biotope attached to the water surface. These organisms are widely distributed in the Pacific Ocean, they are the first to interact with the radioactive falls and might be of great importance in the transfer of Co and Fe radionuclides from the surface microhorizon of the sea to the water thickness and bottom. (auth)

24353 RISK AND COST EFFECTIVENESS ANALYSIS OF UNITED STATES GUIDELINES RELATIVE TO RADIOACTIVITY IN FOODS. Shleien, B. (Bureau of Radiological Health, Rockville, MD). Health Phys.; 29: No. 2, 307-312(Aug 1975).

The Federal Radiation Council's (FRC) guidance is reevaluated as it relates to radioactivity in foods. This is appropriate in light of the recent publications of up-to-date estimates of radiation risk and the continuing application of cost effectiveness evaluations in decision making. An estimate of the radiation risks equivalent to the numerical guides for population doses applicable under normal peacetime operations is presented. The estimated radiation risks are subsequently compared to the societal risks of disease, motor vehicle accidents, and natural disasters. A comparison of this kind is one reasonable approach of putting radiation guidance into a proper prospective. The judicious application of protective actions requires that the cost of the action be consonant with the health savings effected. As an illustration a cost effectiveness analysis on the condemnation of milk containing ^{131}I is presented. The feasibility of applying a protective action is also briefly discussed. (auth)

24354 STRONTIUM-90, CESIUM -137, AND IODINE-131 LEVELS IN POWDERED MILK. Wu, T. Y. (Atomic Energy Council, Taipei, Taiwan); Hsu, C. N.; Wang, C. L.; Weng, P. S. Nucl. Sci. J. (Taiwan); 12: No. 2, 96-102(Jun 1975).

The powdered milk available in the market was monitored to determine the levels of ^{90}Sr, ^{137}Cs, and ^{131}I by both chemical and physical methods. The radionuclide levels found in the powdered milk analyzed since November 1974 are mostly within Range I of the appropriate guidelines with a few samples within Range II,

indicating the need for continued surveillance. The level of ^{131}I in powdered milk is insignificant. A comparison with previous survey performed in 1968-1969 indicates no significant change in fallout levels has been observed. (auth)

Radiometric Techniques

Refer also to abstract 24360.

24355 ISOTOPE COMPOSITION OF EVAPORATING BRINES: EFFECT OF THE ISOTOPIC ACTIVITY RATIO IN SALINE SOLUTIONS. Sofer, Z.; Gat, J. R. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotopes). Earth Planet. Sci. Lett.; 26: No. 2, 179-186(Jun 1975).

An expression is given for the ratio of the activity coefficients of deuterated and light water in chloridic saline solutions as a function of the molality of the salt components. Calculations based on the Craig-Gordon evaporation model show that in the case of evaporating brines, the salt effect on the activity coefficients of the isotopic water species results in deviation of the δ values from a constant slope "evaporation line", when plotted on the conventional δ-diagram, of deuterium concentration versus ^{18}O activity. Conversion of concentration data to activities eliminates these deviations to a large extent, indicating them to be an artifact of the scales employed for measuring the isotope abundance. The origin of Dead Sea waters and other natural brines is dicussed in the light of these findings. (auth)

Site Surveys

24356 (BNWL-SA-5458) ECOLOGICAL IMPACT ASSESSMENT. Thomas, J. M.; Eberhardt, L. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract AT(45-1)-1830. 17p. (CONF-750706-9). Dep. NTIS $4.00.

From ERDA-wide conference on computer support on environmental science and analysis; Albuquerque, New Mexico, USA (9 Jul 1975).

Quantitative problems in accomplishing ecological impact assessment with particular reference to defining population effects are discussed with some comments on the two approaches most commonly used, e.g., the experimental and simulation models. Some alternatives are suggested because both methods will probably fail to detect real population effects mostly due to poor understanding of ecosystems or because of the limitations inherent in field census methods. Most judgments of ecological impact are not quantitatively defensible but are qualitative, subjective, or political in nature. An examination of aggregates of data from various nuclear power plant sites may be one way to obtain enough replication to judge ecological impact. Thus, currently available data from such studies as well as appropriate demographic, vegetation, census, and bibliographic material could offer an interesting challenge to computer professionals if such an undertaking were contemplated. Present research programs at PNL and computer involvement are described. Future possibilities and directions are discussed. (PCS)

24357 (INIS-mf-1694) LAND USE ASSESSMENT AT CHALK RIVER NUCLEAR LABORATORIES: PERCH LAKE AND ENVIRONS. Final Report. Morgan, A. V. (Waterloo Univ., Ontario (Canada)). May 1974. 17p. INIS.

The primary objective of the report is to delimit areas within the controlled region at CRNL which have favorable characteristics for waste disposal. The report concentrates on the Perch Lake Basin, but also outlines areas which should be investigated elsewhere in the AECL property. The author made field examinations of a number of exposures in the CRNL area, primarily in the Perch Lake Basin. Investigations were made of all the available reports pertaining to boreholes drilled in the Basin and the positions of selected boreholes were verified in the field. A number of hand augered sections were attempted, although these frequently resulted in refusal because of the nature of the surficial deposits in the region. Six boreholes were drilled (in three pairs) on the east side of Perch Lake using the University of Waterloo drilling rig. Samples were taken from each of the holes and were returned to the laboratory at the University for analysis. Piezometer nests were installed in each of the six holes to optimize the drilling and to obtain some data on the rates and direction of groundwater flow in this region of the Basin. (INIS)

24358 (PRNC-191) THERMOLUMINESCENCE DOSIMETRY IN NORTHWEST PUERTO RICO. Block, A. M.; Clements, R. G.; Rosa, L. I.; Santos, F. (Puerto Rico Nuclear Center, Mayaguez). 1 Jul 1975. 106p. Dep. NTIS $8.50.

In October, 1973, the Puerto Rico Water Resources Authority sought the initiation of studies aimed at determining background radiological characteristics of the northwestern quadrant of Puerto Rico using thermoluminescent dosemeters. Some of the studies were required for supporting data for the environmental report submitted as part of the licensing procedure in the establishment of thermonuclear electric power generation facilities in Barrio Islote, Arecibo, Puerto Rico. Previous studies of radiological characteristics of the area had been made using sodium iodide sensing equipment in an airplane flying at an altitude of 500 ft. The results are expressed in counts per second, and provide useful comparative levels for radioactivity measured with the thermoluminescent detectors. (CH)

Thermal Effluents

Refer also to abstract 24525.

24359 (CONF-750668-2) DELINEATION OF THERMAL EFFLUENTS DISCHARGED INTO TROPICAL WATERS AROUND PUERTO RICO BY AERIAL INFRARED SCANNING. Wood, E. D. (Puerto Rico Nuclear Center, Mayaguez). 1975. 29p. Dep. NTIS $4.50.

From international solvent extraction conference; The Hague, Netherlands (19 Apr 1971).

Aerial infrared scanning offers a versatile tool with which to monitor thermal discharges and a rapid method of detecting extraneous discharges, whose temperatures differ from the ambient waters. Knowledge of the extent and distribution of thermal effluents is necessary to assist in determining the effects of the added heat upon biota of the region. An AGA Model 680 Thermovision infrared scanner with a 45^0 lens was mounted in a Cessna 182, and flown at altitudes of 600 to 2000 m during night and twilight hours. The detector was InSb, cooled with liquid nitrogen and sensitive to the range 2 to 5.6 mu m. The picture was originally displayed on a color monitor which assigned ten arbitrary colors to shades of gray on the control unit. Isotherms have been assigned using coincidental surface measurements made with a thermometer, read to the nearest 0.1^0C. The data were then recorded on film. Ranges were set at 2^0C and 5^0C, common sensitivities were 0.2^0C and 0.5^0C, respectively. More recently, the data have been recorded on magnetic tapes with a Sabre III instrumentation tape recorder. Observed data have been compared to predictions made using the Pritchard Plume Model. Anomalies can be explained by boundary, wind, and tidal effects. (auth)

Chemical Effluents

Refer also to abstract 24439.

24360 (PRNC-186) TOXIC METALS IN THE ATMOSPHERE. Munoz-Ribadeneira, F. J.; Mo, T.; Canoy, M. J. (Puerto Rico Nuclear Center, Mayaguez). May 1975. 43p. Dep. NTIS $5.25.

Methods used in Puerto Rico for monitoring toxic metals in the atmosphere are described. Air sampling machines are placed at heights from 15 to 25 ft above the surface and the tapes are subjected to neutron activation and gamma spectroscopy. The concentrations of up to 33 elements can be determined with precision and sensitivity without destroying the tapes, which can then be used for analysis by other methods. (CH)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 25110, 25121, 25270, 25305, and 25435.

24361 (AEC-tr-7314, pp 142-151) INPUT ARRANGEMENT OF X-RAY RADIOMETRIC APPARATUS. Varvarisa, V. P.; Isaev, V. S.; Lavrenm'ev, Yu. D.; Kozlov, O. V.; Mamikonyan, S. V. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The accuracy of measurement and the dynamic range of the x-ray radiometric apparatus is mainly determined by its inlet arrangement which includes both the amplifying circuit and the differential discriminator. Specification requirements for the amplifier circuit and the discriminator circuit for a scintillation detector are given, and typical circuits are presented schematically. (WHK)

24362 (HEDL-TME-71-179, pp ANL.9-ANL.13) ERRORS ASSOCIATED WITH ABSOLUTE GAMMA COUNTING. Dec 1971.

In LMFBR reaction rate and dosimetry. Quarterly Progress report, September, October, November, 1971. (Hanford Engineering Development Lab., Richland, Wash. (USA)).

Errors in absolute gamma counting of fission foil detectors using Ge(Li) detectors for measuring neutron flux spectra in the CFRMF reactor are discussed. (WHK)

24363 (HEDL-TME-71-179, pp HEDL.36-HEDL.41) MULTIPLE FOIL TECHNIQUE ERROR ANALYSIS. McElroy, W. N.; Simons, R. L. Dec 1971.

In LMFBR reaction rate and dosimetry. Quarterly progress report, September, October, November, 1971. (Hanford Engineering Development Lab., Richland, Wash. (USA)).

An error analysis study for the CFRMF flux-spectrum as determined by the SAND-II code using a preliminary set of measured reaction rates provided by ANC was completed. The resulting total value of integral flux with assigned uncertainty was used with the measured reaction rates to provide a preliminary set of estimated values of measured spectral averaged cross sections for comparison with SAND-II calculated values. (auth)

24364 (LBL-3869) THREE DIMENSIONAL IMAGE RECONSTRUCTION FROM AXIAL TOMOGRAPHY. Chang, L. T.; Macdonald, B.; Perez-Mendez, V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 15 May 1975. Contract W-7405-Eng-48. 5p. (CONF-750801-2). Dep. NTIS $4.00.

From topical meeting on image processing for 2-D and 3-D reconstruction from projections: theory and practice in medicine and the physical sciences; Stanford, California, USA (4 Aug 1975).

A specific method for producing transverse planes of tomographic images and a more general three dimensional image reconstruction method which removes the effect of off-plane activity from these axial tomograms are presented. Although multiple single-pinhole images are used to make the tomograms, the reconstruction method is applicable to other types of tomographic images such as those from a scanner with focussing collimator or a positron camera. (WHK)

24365 (UCID-16855) WINDOWLESS X-RAY DETECTORS. Gaines, J. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Apr 1974. Contract W-7405-Eng-48. 9p. Dep. NTIS $4.00.

The development of two windowless detectors for monitoring x-ray fluxes down to 1 keV in energy is reported. These detectors are the result of modifications to two detector designs that have been used in the past. These windowless detectors incorporate the basic electrode structure that is used in the bandpass detector described in UCID 16349. However, they differ from the bandpass detectors in that only the center beryllium foil is plated, and it is plated on both sides. The front and back foils are biased by a common supply at positive high voltage. The signal is measured on the center foil. The incident x-rays interact with the aluminum plating generating electrons which are collected on the front and rear beryllium foils. Calibration data are given. (WHK)

24366 ABBE STATISTIC AND ERROR ESTIMATION IN RADIOMETRY. Goloshchapov, N. M.; Kuz'minykh, M. K.; Tsenter, E. M. Meas. Tech.; 17: No. 11, 1784-1786(Nov 1974).

Translated from Izmer. Tekh.; No. 11, 88-89(Nov 1974).

It is usual in radiometric comparison of sources to measure the number of pulses N_W produced by the working source and the number of pulses N_S produced by the standard source in the same time. In such checking work, the measuring sequence is usually standard–working–standard–working. This technique balances out any instability in the instruments due to fast random variations and slow systematic trends, which reduces the overall error of the measurement. This sequence of measurement has long been used in many techniques, but attention is seldom directed to it in works on error evaluation. It is usually assumed that the error of measurement in radiometry is due in the main to the statistical character of the measured quantity, but this is not actually so. The result is in fact substantially influenced by at least six factors, including the error of the measuring instruments. Use of the Abbe criterion for evaluation of the error of the measuring instruments is discussed. (WHK)

24367 SELECTABLE LEVEL ALARMING PERSONAL DOSIMETER. Erickson, G. L. (to U. S. Energy Research and Development Administration). US Patent 3,878,496. G01t1/16. 15 Apr 1975. Filed Date 14 Jun 1971. 12p.

PAT-APPL-152,836.

A pocket type personal dosimeter with selectable dose alarm points is described. The dosimeter uses digital integration to measure the accumulated radiation dose and an audible alarm is provided when a preselected dose has been exceeded. In addition, test circuits are provided and the dosimeter develops an alarm when the dose rate exceeds a predetermined level even though the accumulated dose is less than the preset level. (auth)

24368 CALCULATION OF THE FLUCTUATION ERROR DURING OPERATION OF IONIZING RADIATION DETECTORS IN A CURRENT REGIME. Kositsyn, V. F. Meas. Tech.; 17: No. 11, 1757-1760(Nov 1974).

Translated from Izmer. Tekh.; No. 11, 73-74(Nov 1974).

The connection diagrams of ionizing radiation detectors in a current regime are characterized by the absence of a normalizer. The pulses from the detector go to the integrator without preliminary shaping and differ slightly from one another in amplitude. Therefore, the relative standard deviation due to fluctuations of the integrator's current also increases. This increase can be characterized by the factor η: $\eta = \sqrt{1 + \delta^2(q)}$, where $\delta(q)$ is the relative standard deviation of the recharge of the capacitor of the integrator from the average value of the recharge for an individual pulse. The absence in the literature of the numerical values of η for proportional counters and Geiger–Muller counters, which are often used as radiation detectors, requires that appropriate calculations be made, which are given. (WHK)

24369 ΔE-E TELESCOPE FOR THE IDENTIFICATION OF HEAVY IONS AT LOW ENERGIES WITH GOOD ENERGY RESOLUTION AND OPTIMUM ΔE RESOLUTION. Barrette, J.; Braun-Munzinger, P.; Gelbke, C. K. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Nucl. Instrum. Methods; 126: No. 2, 181-187(1 Jun 1975).

A ΔE-E telescope for the identification of heavy ions at low energies is described. The energy loss is measured with an ionization chamber and the residual energy of the particles is measured with solid-state detector. The energy resolution of the telescope is comparable to the one which is obtained with solid-state detector telescopes. The ΔE resolution is limited by the energy-loss straggling of the particles in the gas and is, therefore, close to the best resolution which can be obtained with this technique. The identification of several heavy ions at low energies is discussed. (auth)

24370 FAST-TIMING MEASUREMENTS USING A CHEVRON MICROCHANNEL PLATE ELECTRON MULTIPLIER. Green, M. I.; Kenealy, P. F.; Beard, G. B. (Wayne State Univ., Detroit, Mich. (USA). Dept. of Physics). Nucl. Instrum. Methods; 126: No. 2, 175-179(1 Jun 1975).

The output pulse shape and timing characteristics of a Bendix Chevron electron multiplier have been investigated. Pulse heights were found to be non-uniform with a maximum height of approximately 1000 mV into 50Ω. The output pulse is about 3 ns wide at half-maximum, triangular in appearance, with rise and fall times of approximately 1.5 ns. The use of the Chevron in a fast-slow delayed-coincidence system is described. ^{60}Co beta-particles were detected by the Chevron and a plastic scintillator was used to detect gamma rays. Prompt fwhm (450 ps), fwtm (850 ps), and slopes (< 80 ps) were obtained. These values are upper limits, as the time resolution was limited by the scintillator arm of the system. Half-life measurements of the 1289.1 keV (1.07 ± 0.10) ns and the 100.1 keV (1.53 ± 0.10) ns levels in ^{182}W were made and found to be in agreement with those found by other investigators. (auth)

24371 SIGNAL LOCATION BY OPEN-CIRCUIT RC LINE. Mathieson, E.; Evans, K. D.; Cole, K.; Everett, R. (Leicester Univ. (UK)). Nucl. Instrum. Methods; 126: No. 2, 199-204(1 Jun 1975).

A description is given of the characteristics of a charge-signal location system, comprising a uniform RC line in near open-circuit termination and conventional waveform-shaping filters, for operation in rise-time mode. Certain universal functions are defined to describe the limits to positional resolution due to system noise. The calculations are supported by measured data on the performance of a resistive-wire line as used in a position-sensitive multi-wire proportional chamber. Comparison is made with short-circuit line operation. (auth)

24372 SELF-QUENCHING EFFECT OF SOLVENTS ON THE PROCESS OF EXCITATION ENERGY MIGRATION IN SCINTILLATING SOLUTIONS. Polacki, Z.; Kilarska, J. (Technical Univ., Danzig). Acta Phys. Pol., Ser. A.; A47: No. 5, 697-706 (May 1975).

Studies of photoluminescence self-quenching of dioxane solutions of styrene, anisole and toluene are reported. The process of styrene polymerization as well as the process of the formation of anisole and toluene excimers can be regarded as the cause of self-quenching. It was found that radioluminescence yield scintillation decay times, and quantum yields of energy transfer of styrene and toluene solutions of PPO diluted by dioxane, depended on the self-quenching of the solvents. Rate constants of excitation energy transfer in the range of self-quenching decrease with the increase of donor concentration. The yield of excitation energy transfer from dioxane to PPo is estimated in the case of solution excitation by γ-radiation. (auth)

24373 USE OF HIGH-PURITY GERMANIUM DETECTORS FOR INTERMEDIATE-ENERGY PHYSICS EXPERIMENTS. Amann, J. F.; Barnes, P. D.; Dytman, S. A.; Penkrot, J. A.; Thompson, A. C. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)); Pehl, R. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Instrum. Methods; 126: No. 2, 193-198(1 Jun 1975).

The applicability of high-purity germanium detectors for charged-particle detection of intermediate-energy particles was evaluated with a two-detector system. The energy resolution for 100 MeV protons and 50 MeV positive pions was measured. The sensitivity of the detectors to radiation damage was estimated and the repair of the detectors was demonstrated. (auth)

24374 SIMPLE INSTRUMENT FOR THE DETERMINATION OF TRITIUM IN MIXTURES OF HYDROGEN ISOTOPES. Lewkowicz, I.; Rosmann, M. (Soreq Nuclear Research Centre, Yavne, Israel). Nucl. Instrum. Methods; 126: No. 1, 149-151 (15 May 1975).

An instrument for the determination of tritium in mixtures with the other hydrogen isotopes is described. It includes a small ionization chamber, a power supply, and a measuring circuit. Its readings are proportional to the tritium concentration and are independent of the deuterium/protium ratio. The instrument can be used under both static and flow conditions, and does not require dilution of the tritium. (auth)

24375 POSITION-SENSITIVE DETECTORS (P.S.D.) FOR NEUTRON DIFFRACTION. Allemand, R.; Bourdel, J.; Roudaut, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)); Convert, P.; Ibel, K.; Jacobe, J. (Institut Max von Laue – Paul Langevin, 38 - Grenoble (France)); Cotton, J. P.; Farnoux, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Nucl. Instrum. Methods; 126: No. 1, 29-42(15 May 1975).

Several types of position-sensitive detectors for thermal neutrons in a gaseous environment (BF_3, ^3HE), called multidetectors, have been designed, constructed, and tested on several neutron-diffraction experiments. They have made possible a considerable saving in time in relation to conventional diffractometers. The following instruments are described: (1) A curved multidetector with 400 cells: position-sensitive in a single dimension for the study of powder spectra; angular aperture: 80°, angular resolution: 12' in 2θ, radius of curvature: 150 cm. (2) A plane multidetector with 4096 cells: position-sensitive in two dimensions X, Y (64 × 64 cells at 10 mm spacing), intended for small-angle scattering studies. (3) A plane multidetector permitting position sensing in polar coordinates: this consists of 29 concentric circles at 10 mm spacing and 36 angular sectors. The main results obtained for each of these are given. The technological solutions used have made it possible to achieve excellent stability of the characteristics with time. (auth)

24376 SPECTROMETRIC PROPERTIES OF A HIGH-EFFICIENCY FAST NEUTRON DETECTOR. Costa, S.; Ferrero, L.; Pasqualini, L. (Turin Univ. (Italy). Istituto di Fisica). Nucl. Instrum. Methods; 126: No. 1, 25-28(15 May 1975).

The absolute efficiency vs neutron energy of BF_3 counters immersed in paraffin at five distances from the source has been evaluated using Monte Carlo techniques. The neutron energy ranged from 0.5 to 50 MeV. The results are discussed in the perspective of designing actual neutron detectors with high efficiency and low-resolution spectrometric properties. A "weighting functions" method is proposed to analyze the experimental data. (auth)

24377 ULTRAVIOLET CHERENKOV LIGHT DETECTOR. Baillon, P.; Declais, Y.; Ferro-Luzzi, M.; French, B.; Jenni, P.; Perreau, J. M.; Seguinot, J.; Sequinot, J.; Ypsilantis, T. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 126: No. 1, 13-23(15 May 1975).

An increase by a factor ~3.4 in photoelectron emission from Cherenkov light has been observed after coating a standard photomultiplier of the XP1040 class (Philips) with a thin deposit of scintillating material (wavelength shifter). The coating operation is straightforward and requires simple manipulations. Coated phototubes have been used in a conventional gas Cherenkov counter exposed to an electron beam at the CERN PS. A figure of merit for the system of $N_0 \sim 170$ photoelectrons per cm, is measured. (auth)

24378 SIMPLE METHOD FOR CHARGED-PARTICLE IDENTIFICATION. Ploskonka, J.; Zastawniak, L.; Zybert, R. (Uniwersytet Jagiellonski, Krakow (Poland). Instytut Fizyki). Nucl. Instrum. Methods; 126: No. 1, 57-59(15 May 1975).

The simple method for charged-particle identification proposed by Renaud was experimentally tested using a ΔE and E semiconductor detector telescope. The function realized electronically was: $\log \Delta E + \mu \log E_{tot}$. The obtained results for p, d, t, and ^4He identification are shown and seem to be quite satisfactory. (auth)

24379 STUDY OF HEAVY ION TRACKS IN CELLULOSE TRIACETATE FILMS PREIRRADIATED OR NOT WITH GAMMA RAYS. Vareille, J. C.; Barussaud, A.; Moliton, J. P.; Teyssier, J. L. (Limoges Univ., 87 (France). Lab. des Radiations Ionisantes). Nucl. Instrum. Methods; 126: No. 1, 61-68(15 May 1975). (In French).

Cellulose triacetate produced by a method developed in the laboratory is studied as a solid-state track detector. It is bombarded by Ar ions, alpha particles and fission fragments of californium. It is shown that the detector response is affected by the concentration of the plasticizer. The effects of γ preirradiation on $\bar{V}_g$ are correlated with the results from infrared investigations. In the dosage range of $1.9 \times 10^6 - 11.4 \times 10^6$ rads, the ion tracks are not significantly changed, which is explained by a comparison between the energy provided by the bombarding ions and the energy deposited by the γ rays. (auth)

24380 CONVOLUTION AND DECONVOLUTION TECHNIQUES APPLIED TO CHERENKOV DETECTORS. Lezniak, J. A. (New Hampshire Univ., Durham (USA)). Nucl. Instrum. Methods; 126: No. 1, 129-147(15 May 1975).

The problem of extracting a differential kinetic energy spectrum from a pulse height distribution obtained with a Cherenkov detector is explored. An approximate approach to correcting for the effect of Cherenkov detector broadening is presented and then a more complete technique is developed and applied to several examples. (auth)

24381 TIMING PROPERTIES OF A ZnO(Ga) SCINTILLATOR (NE843). Batsch, T.; Bengtson, B.; Moszynski, M. (Institute of Nuclear Research, Warsaw (Poland)). Nucl. Instrum. Methods; 125: No. 3, 443-446(15 Apr 1975).

A study of the scintillation pulse shape from the inorganic scintillator NE843 [multicrystalline powder of ZnO(Ga)] shows that the difference of two exponentials approximates the pulse shape very well. The rise and decay time constants are found to be about 0.3 ns and 1.5 ns, respectively. A comparison of the initial delay of the scintillation pulse with respect to the impinging of the radiation demonstrates that the energy-transfer process is much faster in NE843 than in the fast binary plastic scintillator NE111. Because of the faster transfer of energy prior to light emission, the time-resolution curve for NE843 is narrower than that for NE111, when the same number of photoelectrons are selected. The fwhm time resolution of NE843 on a XP1021 photomultiplier is equal to 560 ps for 20 photoelectrons. The number of photoelectrons is higher than for NE111 observed for 5.4 MeV α particles. Unfortunately, because of self-absorption of light, and not complete stopping of the α particles, there is no peak in the pulse-height distribution from the NE843 scintillator. (auth)

24382 EFFECTS OF PRE-IRRADIATION ANNEALING ON THE TRACK-DEVELOPMENT PROPERTIES OF SOLID STATE NUCLEAR TRACK DETECTORS. Khan, H. A. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi). Nucl. Instrum. Methods; 125: No. 3, 419-423(15 Apr 1975).

The effects of pre-irradiation annealing on the track registration and development properties of various cellulose-nitrate and polycarbonate plastic track detectors have been studied. The results show that, as the pre-irradiation annealing temperature is raised, the track-registration efficiency of most of the detectors at first shows a marked increase and then a slight decrease. Also, pre-irradiation annealing results in a significant decrease in the background etch pits. There are indications that, as the temperature is raised gradually, the degree of polymerization increases which, in turn, hardens the material and thus decreases the general etching velocity, G_g. There seems to be very little effect on V_t, the velocity along the damage trail produced after annealing; but due to a decrease in V_g, the ratio V_t/V_g increases, and a net gain in efficiency and maximum etched track length is achieved. At higher temperatures, some sort of a breakdown takes place which results in an increase in V_g, thus decreasing the detection efficiencies and the maximum etched track lengths. (auth)

24383 RESPONSE OF VARIOUS THIN-FILM SCINTILLATORS TO LOW-ENERGY PARTICLES. Kohl, J. W. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). Nucl. Instrum. Methods; 125: No. 3, 413-417(15 Apr 1975).

The response of several different types of plastic thin-film scintillator detectors (TFD) to low-energy protons and alpha particles is presented. Film thicknesses vary from ~50 $\mu g/cm^2$ to ~400 $\mu g/cm^2$. Particle energies vary from ~0.05 MeV/nucleon to ~2.5 MeV/nucleon and are both penetrating and non-penetrating. The results extend previously published work and are consistent with it. Response of the TFDs shows the effect of ionization quenching at low energies and the non-linearity of light output with deposited energy (ΔE). The double-valued nature of specific luminescence ($dL/d\chi$) as a function of specific energy loss ($dE/d\chi$) suggested by Muga and Griffith is confirmed. (auth)

24384 INFLUENCE OF PLASMA EFFECTS ON THE TIMING OF FISSION FRAGMENTS WITH SEMICONDUCTOR DETECTORS. Henschel, H.; Hipp, H.; Kohnle, A.; Goennenwein, F. (Tuebingen Univ. (F. R. Germany). Physikalisches Inst.). Nucl. Instrum. Methods; 125: No. 3, 365-372(15 Apr 1975).

For fission fragments incident on surface-barrier detectors of low resistivity ($\rho \sim 400\ \Omega$ cm) the dependence of the fast current signal on field strength and local resistivity variations of the basic material has been studied. It is well known that with the fast signal as timing reference a time shift is observed when varying the bias voltage. This is due to a change in plasma time. The additional variation of plasma time with mass and/or energy of the heavy ions necessitates a time-walk correction in fission-fragment time-of-flight studies, which has been determined by two independent methods to be about ±200 ps for the mean light and heavy fragment of binary fission from ^{252}Cf. Local resistivity changes of the silicon wafer the detectors are made from, give rise to local plasma-time shifts, which spoil the time resolution of large-area detectors. For a narrow well-collimated beam of fission fragments an optimum time resolution of 215 ps has been obtained. (auth)

Radiation Dosimeters

Refer also to abstract 25175.

24385 (AEC-tr-7314, pp 173-184) RADIATION MICRO-CALORIMETER WITH SEMICONDUCTOR THERMOMETRIC DETECTORS. Vukolov, Yu. N.; Ostretsov, L. A.; Polyakov, L. N.; Radiksov, V. D. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

In the calculation of the heat release from hermetically highly active sources applied in isotopic sources of electrical energy as fuel blocks, it is necessary to know the real features of the isotopic fuel such as specific heat release, specific activity, activity for unit heat power, etc. The measurement of the indicated values, aiming at the radioactive safety control for work with radioactive isotopes, is advantageously carried out on specimens of low activity. The determination of the heat liberation of such specimens is related to the measurement of small temperature differences in a microcalorimeter. A double calorimeter was used. With this calorimeter, the radiation and the thermophysical characteristics of the radioactive samples based on the isotopes ^{90}Sr, ^{144}Ce, ^{137}Cs and ^{238}Pu were investigated. It is enclosed by a massive aluminium housing 10 mm thick. This housing ensures a homogeneous temperature field on the inside. Results are presented. (WHK)

24386 (AEC-tr-7314, pp 185-190) RADIATIONAL ALPHA-BETA CALORIMETER. Vukolov, Yu. N.; Ostretsov, L. A.; Polyakov, L. N.; Radiksov, V. D. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The calorimeter is designed in the form of two cylindrical dismountable chambers of copper with a chromeplated surface. The bottoms of the chambers on which are disc thermocouple detectors for the heat flux and plugs for connecting the remote-detachable heaters of the stecker type are fixed on the panels. The bases are closed at the top by dismountable covers and dismountable thermoisolating screens. The cold soldered joints of the thermocouples are fixed in a special screened coil positioned at the lower side of the panel. The thermocouple detectors and heaters are switched, through dismountable plugs, to circuits for measuring the thermoelectromotive force, the power supply and the power measurement. The calorimetric chambers and the screens are thermoisolated from the carrying panel of the calorimeter by teflon paddings. The calorimeter is established in a horizontal position by jaw-screws. The thermocouple detectors, the coils of the cold joints and the wire leading to the plugs for feeding the heaters are closed by a screen. The circuits for feeding the electroheaters and the measurement of the power supplied to it together with the circuit for measuring the thermoelectromotive force enter in the electric circuit of the calorimeter. The heat release power in the heaters is measured by potentiometric circuits or by ammeters and voltmeters of high accuracy. Calibration curves are given. (WHK)

24387 INSTALLATION FOR TESTING DOSIMETRIC INSTRUMENTS. Stomataki, V. I.; Starish, A. I.; Vasil'eva, L. N. Meas. Tech.; 17: No. 11, 1674-1675(Nov 1974).

Translated from Izmer. Tekh.; No. 11, 26-27(Nov 1974).

The equipment UPGD-1M (in its modernized version) which consists of three automated units, comprising a device for delivering sources to the collimator, a unit for automatic displacement of the table with the tested instrument and its stopping at a given point of the calibrated rule, and a television equipment for observing the tested instruments' scale is described. (WHK)

24388 DEVICE FOR TESTING INDIVIDUAL GAMMA DOSIMETERS. Vasil'eva, L. N.; Stromataki, V. I. Meas. Tech.; 17: No. 11, 1676(Nov 1974).

Translated from Izmer. Tekh.; No. 11, 27(Nov 1974).

The ionizing radiations department of the Odessa Interregional State Inspection Laboratory (MOLGN) has produced a device for testing gamma dosimeters on the UPGD-1M installation. It consists of a set of special gamma-dosimeter cassettes which are located on stands within the boundaries of the uniform ionizing-radiations field. The design of the cassettes is suitable for locating the gamma dosimeters easily in the same plane strictly perpendicular to the radiation beam direction and fixing the distance between cassettes according to the length of gamma dosimeters. With a collimator diameter of 60 mm and ^{60}CO source of 5 Ci it is possible to test simultaneously 100 to 160 gamma dosimeters depending on the working distance in the range of 150 to 200 cm. The cassettes can be set in any sequence on the testing rule. Their "charging" by the gamma dosimeters is carried out outside the test room. This device makes it possible to test efficiently a large number of aggregates with a few gamma dosimeters. Each cassette is numbered. The "working field" of cassettes is divided into intervals denoted by letter and figure indexes. This serves to process the measurement results very rapidly and enter them in the test reports. The letter and figure coding of cassettes also eliminates the "marking" of various gamma dosimeters. For denoting on the cassettes the uniform-field sizes at various working distances color coding is used. (WHK)

24389 FAST-NEUTRON DOSIMETRY BY MEANS OF A CELLULOSE-NITRATE DETECTOR. Tripier, J.; Oppel, R.; Remy, G.; Debeauvais, M. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Lab. de Physique Corpusculaire). Nucl. Instrum. Methods; 125: No. 3, 487-489(15 Apr 1975).

Rapid information on fast-neutron fluences is obtained from detection of the tracks of charged particles produced by fast neutrons directly in cellulose nitrate, and automatic evaluation. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 24421.

24390 (AEC-tr-7314, pp 68-77) MATRICES OF THE COMPTON CONTRIBUTIONS FOR A MONOCRYSTAL SCINTILLATION γ-SPECTROMETER IN THE ENERGY INTERVALS UP TO 1276 AND 1836 keV. Efremov, V. G.; Lebedev, V. P.; Ostretsov, L. A.; Forafantov, N. V. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

A method for plotting the matrix of Compton contributions in complex γ spectra from a scintillation spectrometer is described. The results of the graphical interpolation and extrapolation are given. (WHK)

24391 (AEC-tr-7314, pp 77-82) INSTRUMENTAL METHOD FOR THE TREATMENT OF CONTINUOUS γ-SPECTRA. Efremov, V. G.; Lebedov, V. P.; Ostretsov, L. A.; Stolyarov, V. P.; Forafontov, N. V. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The introduction of Compton corrections in the treatment of continuous γ-spectra is a complex and highly laborious task which is realised at present by the matrix and graphical methods. The aim of the present work was to investigate a new faster method which is called "instrumental". The idea of the method lies in the following. It is based on the assumption that the continuous Compton distribution, obtained for an organic crystal of stilbene (anthracene) from a certain γ conversion in conditions of selected geometry, duplicates the continuous Compton distribution obtained from the same conversion on the inorganic crystal NaI(Tl). On this basis it is possible to try, by changing the electrical parameters of the circuit and the relative positions of the source and detector, to superimpose to the maximum possible degree the Compton distribution in both crystals at a certain energy interval. Then, the introduction of the Compton correction in the instrumental γ-spectrum, obtained from the investigated source on the NaI(Tl) crystal, will involve the graphical substraction of the instrumental Compton distribution obtained from the same source on the stilbene crystal from the instrumental γ-spectrum. (WHK)

24392 (AEC-tr-7314, pp 83-86) COMPARISON OF THE MATRIX, GRAPHICAL AND INSTRUMENTAL METHODS OF TREATMENT OF CONTINUOUS γ-SPECTRA IN THE SPECTROMETRIC INVESTIGATION OF INDUSTRIAL PROTOTYPES WITH PREPARATIONS BASED ON ^{147}Pm ISOTOPE. Efremov, V. G.; Lebedov, V. P.; Ostretsov, L. A.; Forafantov, N. V. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The aim of the present work is the comparison of the matrix, graphical and instrumental methods of the treatment of complex γ-spectra taking as an example the investigation of the impurity composition of Pm^{147}. The introduction of the Compton correction is of primary importance in the treatment of complex γ-spectra. A treatment is carried out of the instrumental γ-spectrum of the prototype of a preparation based on Pm^{147} isotope. The γ-spectrum was made using a scintillation gamma-spectrometer with a NaI(Tl) crystal 40 × 40 mm. The results of the treatment are given. (WHK)

24393 (AEC-tr-7314, pp 136-141) INVESTIGATION OF THE COUNTERS USED FOR THE REGISTRATION OF X-RAY QUANTA. Kozlov, O. V.; Mamikonyan, S. V.; Martischchenko, L. G.; Filatov, V. I. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Data are given on the characteristics of gas-discharge counters and x-ray filters. The characteristics of the proportional counters SI-6R and SI-2B were investigated and the possibility of their application for x-ray analysis is determined. The energy dependence of the sensitivity and energy resolution is presented graphically. (WHK)

24394 (BNL-20195) PDP-11 SPECTROMETER CONTROL SYSTEM. Users Guide. Pynn, R.; Youngblood, R. (Brookhaven National Lab., Upton, N. Y. (USA)). Jun 1975. 32p. Dep. NTIS $4.00.

A manual for programming and operating the PDP-11 spectrometer control system is presented. (WHK)

24395 (CONF-750303-74) RENSSELAER INTENSE NEUTRON SPECTROMETER. Block, R. C.; Hockenbury, R. W.; Cramer, D. S.; Bean, E.; Slovacek, R. E. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA); Knolls Atomic Power Lab., Schenectady, N. Y. (USA)). 1975. 7p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The Rensselaer Intense Neutron Spectrometer (RINS) is obtained by driving a 75-ton lead slowing down spectrometer with the intense pulsed neutron source from the RPI 100-MeV electron linac. For the same linac beam power, RINS produces a useable neutron flux which is 10^3 to 10^4 greater than that obtained with a conventional time-of-flight spectrometer. Fission measurements upon ^{239}U have shown strong subthreshold fission above 700 eV and have determined the fission widths of the 6.7, 21 and 37 eV resonances to be (10 ± 5), (70 ± 30) and (8 ± 6) neV respectively. No strong subthreshold fission was observed in ^{232}Th, and an upper limit of (15 ± 10) neV is obtained for anti GAMMA/sub f/ for the Th resonances below 260 eV. Measurements of ^{145}Nd (n, alpha) have shown that the RINS system is readily capable of measuring approximately mu eV partial widths with only several mg of sample. (auth)

24396 (ORNL-tr-2941) ANALYTICAL FUNCTIONS REPRESENTING RESPONSE FUNCTIONS OF NaI(Tl) DETECTOR SYSTEMS TO GAMMA RAYS. Sekine, T.; Baba, S.; Baba, H. Sep 1971. Translation by H. Kubota of JAERI-M-4590. 48p. Dep. NTIS $5.50.

An analytical function for describing the response function of gamma rays from the NaI(Tl) detector system was developed with the purpose of establishing the method of automatic gamma-ray analysis. The response was found to be divided in six portions; the function of each portion joins smoothly the function representing the adjacent portion. The gamma-ray energy dependence of parameters specifying the functions was determined experimentally. The response function obtained was fitted to the observed spectrum by the method of least squares. The calculated value agreed well with the observed one, in which a measure of the degree of fit was introduced, giving the consistent result with visual inspection. The spectrum composed of two gamma-rays artificially synthesized was analyzed by the least-squares and the graphical photopeak methods. The peak area by least-squares fit was found to be better than that by the graphical photopeak method. The base-line shift of the pulse with the source intensity was examined for two NaI(Tl) detectors. Considerable base-line shift was observed in one detector, whereas practically none in the other. (auth)

24397 HEAD PART OF THE CRYOSTAT FOR AN SI(Li) SPECTROMETER. Khomyakov, G. K.; Serykh, N. V.; Shakun, N. A.; Strashinskii, A. G. (Inst. of Technical Physics, Kharkov). Instrum. Exp. Tech.; 17: No. 6, 1772-1773(1974).

Translated from Prib. Tekh. Eksp.; No. 6, 183-185(1974).

This spectrometer is intended for x rays and soft γ rays, and it contains a cooled field-effect transistor type KP303, which is the input amplifying unit for a low-noise preamplifier. The energy resolution on the 13.96 keV line of ^{241}Am is 480 eV. The inherent resolution of the preamplifier with zero input capacity is 320 eV. The spectrometer has been used to determine trace amounts of Fe, Ni, Cu, Ga, and Ta from the characteristic x rays excited by 3 MeV protons. Experimental spectra are presented. (auth)

24398 STABLE PULSED LIGHT SOURCE. Ngo Quok Byu; Kramarenko, V. A.; Malakhov, A. I.; Khachaturyan, M. N.; Khvastunov, M. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech.; 17: No. 6, 1747-1749(1974).

Translated from Prib. Tekh. Eksp.; No. 6, 163-164(1974).

A stable pulsed light source with a pulse-height resolution of 5.2% using a NaI(Tl) crystal and a ^{241}Am α source is described. The characteristics of 90 light sources are reported. The light flash of the source is equivalent to the Cherenkov radiation of a shower generated by a 1.2-GeV electron. The constant-intensity pulsed light sources is used to monitor the stability of the spectrometric system in operation with a spectrometric apparatus containing a photomultiplier and a scintillator or Cherenkov radiator. (auth)

24399 LARGE-AREA LITHIUM-FLUORIDE BRAGG SPECTROMETER FOR STELLAR X-RAY ASTRONOMY. Stockman, H. S. Jr.; Angel, J. R. P.; Woodgate, B. E. (Columbia Univ., New York (USA)); Nidey, R. A. (Kitt Peak National Observatory, Tucson, Ariz. (USA)). Nucl. Instrum. Methods; 126: No. 2, 217-220(1 Jun 1975).

A large-area Bragg spectrometer recently used to search for the Fe XXV X-ray emission lines in Sco X-1 is described. The instrument employs 3400 cm^2 of LiF and has the capability of detecting a narrow line flux from Sco X-1 of approximately 10^{-2} photons $(cm^2 s)^{-1}$ at 6.7 keV. (auth)

24400 DETERMINATION OF SPECTRA FROM PULSE-HEIGHT DATA. Arnold, E. B. (Michigan Univ., Ann Arbor (USA). Randall Lab. of Physics). Nucl. Instrum. Methods; 125: No. 3, 391-395(15 Apr 1975).

A method for determining parameters of a physical spectrum from pulse-height data is described. This method is designed to utilize information from the entire range of data and possesses advantages over other methods in use which arbitrarily restrict the input-data range used for parameter determination. Applications on two problems in β-spectroscopy are made. This method is most useful in those cases in which the information is distributed fairly smoothly over many data points. The statistical errors associated with the parameters may be determined in a straightforward manner. (auth)

24401 FITTING OF LORENTZIAN TO MOESSBAUER SPECTRA BY NONITERATIVE METHOD. Mukoyama, T. (Kyoto Univ. (Japan)). Nucl. Instrum. Methods; 126: No. 1, 153-154 (15 May 1975).

A method for fitting a Lorentzian function in which iterative procedures are not needed is presented. The method utilizes a linearization technique of the Lorentzian function and the standard linear least-squares fitting. The validity of the proposed method has been successfully tested against the experimental Moessbauer spectrum, and a comparison with the conventional iterative least-squares method has been made. (auth)

24402 SPAN: A FORTRAN PROGRAM FOR ROUTINE AND DETAILED ANALYSIS OF GAMMA SPECTRA USING A SMALL COMPUTER. Basu, S. K.; Patro, A. P. (Saha Inst. of Nuclear Physics, Calcutta (India)). Nucl. Instrum. Methods; 126: No. 1, 115-123(15 May 1975).

A computer code "SPAN" written in FORTRAN for an IBM 1130 (16K) computer is described which is capable of both routine as well as accurate detailed analysis of high-resolution gamma spectra. It has been shown that a simple Gaussian representation for photopeaks is a good approximation as long as the statistics are not very high. It has been demonstrated that for peaks with high statistics, a sum of two Gaussians instead of one can account for the observed low-energy tail which is approximated by various empirical functions in the existing codes. A non-linear least-squares fitting routine is included which is based on a simplified version of an iterative gradient minimisation method with variable metric. Results of analysis of a test spectrum of ^{171m}Lu by the present code "SPAN" and by the widely used code "SAMPO" are presented and compared. (auth)

High Energy Physics Instrumentation

24403 (BNL-20202) BNL MULTI-PARTICLE SPECTROMETER (MPS) FACILITY. Lindenbaum, S. J. (Brookhaven National Lab., Upton, N. Y. (USA); City Coll., New York (USA)). May 1975. 26p. (CONF-750547-10). Dep. NTIS $4.50.

From 4th international symposium on nucleon-antinucleon interactions; Syracuse, New York, USA (2 May 1975).

The general characteristics, state of progress, and planned future improvements for the Brookhaven Multi-Particle Spectrometer are discussed; also, its potential for studying N anti N and other interactions are discussed. (WHC)

24404 (JINR-P10-8748) MODE OF AUTOMATIC TRACK FOLLOWING PROGRAM SAMET FOR SCANNING-MEASURING TABLES. Bogachev, N. P.; Govorun, N. N.; Grivnyak, Ya. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 15p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The method of operation of the automatic track following program constructed at JINR for application to scanning-measuring tables controlled by a BESM-4 computer is described. (auth)

24405 DEFLECTION-CURRENT GENERATOR FOR A SCANNING DEVICE. Tarasov, V. M.; Panikovskii, S. I.; Abramov, V. G. (Tomsk Polytechnical Inst., USSR). Instrum. Exp. Tech.; 17: No. 6, 1678-1680(1974).

Translated from Prib. Tekh. Eksp.; No. 6, 111-113(1974).

The theoretical circuit is described for a deflection-current generator using a digital-to-analog converter with current output, which uses summation of standard currents in a load, which is a push-pull focussing and deflecting system type FOS 36/40. This circuit gives low currents I_m of 750 mA into an array of 512 × 512 elements in a time of about 3 sec. The scanning systems based on electron-beam tubes are used in encoding films from spark and bubble chambers. (auth)

24406 MEASUREMENTS ON THE DEVELOPMENT OF CASCADES IN A TUNGSTEN-SCINTILLATOR IONIZATION SPECTROMETER. Cheshire, D. L.; Huggett, R. W.; Johnson, D. P.; Jones, W. V.; Rountree, S. P. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy); Schmidt, W. K. H. (Max Planck Institut fuer Extraterrestrische Physik, Garching bei Muenchen F. R. Germany); Kurz, R. J. (TRW Systems, Redondo Beach, Calif. (USA)); Bowen, T.; Delise, D. A.; Krider, E. P. (Arizona Univ., Tucson (USA). Dept. of Physics). Nucl. Instrum. Methods; 126: No. 2, 253-262(1 Jun 1975).

The response of a tungsten-scintillator ionization spectrometer to accelerated particle beams has been investigated. Results obtained from exposure of the ~1000 g/cm^2 apparatus to 5, 10, and 15 GeV/c electrons and pions as well as to 2.1 GeV/nucleon ^{12}C and ^{16}O ions are presented. These results include cascade-development curves, fractions of the primary energy measured by the spectrometer, and resolutions of the apparatus for measuring the primary energies. The response of spectrometers having smaller depths than 1000 g/cm^2 was estimated by successively omitting signals from the downstream end of the modular apparatus. For 15 GeV/c electrons, an average of ~82% of the incident energy is measured by the apparatus with resolution (normal standard deviation) of ~6%. For 15 GeV/c pions, an average of ~65% of the incident energy is measured with resolution of ~18%. The energy resolution improves with increasing energy and with increasing depth of the spectrometer. (auth)

24407 STEREO SEARCH. A Lateral Approach to Automatic Bubble-Chamber Measurement. Raja, R. (Cambridge Univ. (UK). Cavendish Lab.). Nucl. Instrum. Methods; 126: No. 2, 247-251(1 Jun 1975).

A new approach to automatic bubble-chamber measurements is described that enables one to completely automatize the measurements of tracks after the first view and the vertex on the second view are measured. Alternately this information may be obtained from predigitisations. The tracks on subsequent views are measured in the same order as they are measured on the first view, thus eliminating the need for track matching altogether. The method described is general and may be applied to complex as well as simple optics, and is suitable for any type of automatic bubble-chamber measuring machine. (auth)

24408 MANUFACTURE OF LIGHT-WEIGHT MIRRORS FOR CHERENKOV COUNTERS. Bourdinaud, M.; Baracat, A.; Poivilliers, J.; Thevenin, J. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Nucl. Instrum. Methods; 126: No. 2, 281-284(1 Jun 1975).

This text deals with a process of manufacturing light-weight mirrors used principally in Cherenkov counters and spatial apparatus. The process itself, based on the use of synthetic resin poured onto glass plates, is described. The results obtained with this technique and their applications are presented. (auth)

24409 LATERAL DISTORTIONS OF ELECTROMAGNETIC CASCADES IN EMULSION CHAMBERS. Porter, L. G.; Levit, L. B.; Jones, W. V.; Huggett, R. W.; Barrowes, S. C. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). Nucl. Instrum. Methods; 126: No. 1, 69-74(15 May 1975).

Electromagnetic cascades in a lead-emulsion chamber have been studied to determine the effect of air gaps on the upstream sides of the emulsions. Such air gaps cause a change in the form of the radial distribution of electron tracks, making cascades appear older and giving incorrect energy estimates. The number of tracks remaining within a radius r was found to vary as exp (-g/G), where g is the gap thickness. The characteristic gap thickness in mm is $G = 3.04 + 1.30 \ln(Er^2\ \mathrm{GeV^{-1}\ mm^{-2}})$, where E is the energy of the initiating gamma ray. Use of this relation provides a significant correction to cascade-energy estimates and allows one to calculate the effect of different gap thicknesses on the energy threshold for visual detection of cascades. (auth)

24410 OVERLAY SYSTEM FOR DATA ACQUISITION IN HIGH-ENERGY PHYSICS EXPERIMENTS. Dufournaud, D.; Minard, M. N.; Willitts, T. R. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Nucl. Instrum. Methods; 126: No. 1, 103-108(15 May 1975).

Software is described which is based on an 8k-work 16-bit computer, a fixed-head disc, and a data link to a large computer centre. It has been used at CERN to take data and to control an experiment using multi-wire proportional chambers with a total of 6000 wires. (auth)

24411 LARGE-AREA MAGNETIC SPECTROMETER FOR THE STUDY OF HIGH-ENERGY NEUTRINO INTERACTIONS. Benvenuti, A.; Cline, D.; Ford, W. T.; Imlay, R.; Ling, T. Y.; Mann, A. K.; Messing, F.; Pilcher, J.; Reeder, D. D.; Rubbia, C. (Harvard Univ., Cambridge, Mass. (USA). Dept. of Physics). Nucl. Instrum. Methods; 125: No. 3, 457-460(15 Apr 1975).

The design, construction, and performance of a large solid iron magnetic spectrometer which has been used to identify and measure the momentum of muons produced by interactions of neutrinos with nucleons is described. The rms momentum resolution varies from 10 to 15 percent between 5 and 150 GeV/c. (auth)

24412 LIQUID-SCINTILLATOR TOTAL-ABSORPTION HADRON CALORIMETER FOR THE STUDY OF NEUTRINO INTERACTIONS. Benvenuti, A.; Cline, D.; Ford, W. T.; Imlay, R.; Ling, T. Y.; Mann, A. K.; Messing, F.; Pilcher, J.; Reeder, D. D.; Rubbia, C. (Harvard Univ., Cambridge, Mass. (USA). Dept. of Physics). Nucl. Instrum. Methods; 125: No. 3, 447-456(15 Apr 1975).

The performance of a large-volume liquid-scintillator calorimeter which has been used to measure the total energy of hadrons produced by interactions of neutrinos with nucleons is described. The resolution of the calorimeter is about 12% rms for incident pions over the energy range 20 to 150 GeV, and about 15% for neutrino-induced hadron systems in the chosen fiducial volume after corrections for imperfect energy containment. (auth)

24413 METHOD FOR ON-LINE OPTICAL TAGGING OF BUBBLE-CHAMBER TRACKS. Settles, R.; Manz, A.; Marraf-

fino, J.; Hansl, T. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)); Reucroft, S. (Vanderbilt Univ., Nashville, Tenn. (USA). Dept. of Physics); Peyrou, C. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 125: No. 3, 435-442(15 Apr 1975).

A method for optically tagging the tracks of a bubble-chamber event which has been selected by an electronic trigger is described. The method consists in reducing the contrast of the unwanted background tracks in the photograph, whereby the scanning and measuring of the film may be considerably facilitated. The principle of the method is, that the unwanted tracks are photographed twice sequentially, first with dark-field then with bright-field illumination, while the wanted tracks are photographed only with bright-field illumination. Thereby use is made of the fact that, for a proper choice of lense aperture, the contrast of a bubble is practically negligible in the first 100 μs of its growth to a photographable size. Further requirements of the method are the operation of a bubble chamber together with a slow-spill beam and a kicker magnet to interrupt the beam entry into the chamber at the time of the trigger. Results of the tests of the method with the Hyperon Bubble Chamber HYBUC are presented. (auth)

24414 NEW TOTAL-ABSORPTION SHOWER-CASCADE DETECTOR. Krienen, F.; Walker, E. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 125: No. 3, 349-352(15 Apr 1975).

The proposed total-absorption shower-cascade detector consists of barium fluoride (BaF_2) crystals, immersed in the liquid decalin $C_{10}H_{18}$, the index of refraction of both substances being the same. The detector has been tested in electron beams in the 1 GeV range. Preliminary results on a cylindrical sample, 12 radiation lengths long and with a diameter of 2.4 radiation lengths, show that the separation of 350, 500, 750, and 1000 MeV electrons is quite good. (auth)

24415 QUARTZ-WINDOW DESIGN FOR GAS-PRESSURIZED PHOTOMULTIPLIER-TUBE INSTALLATION. Bailey, B. M. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Nucl. Instrum. Methods; 125: No. 3, 353-355 (15 Apr 1975).

The design and testing of a quartz window to provide optical access to the interior of a 20-atmosphere threshold gas Cherenkov counter is described. The resulting installation permits more than 90 percent of the incident radiation in the 220- to 350-nanometer range to reach a 58DVP photomultiplier tube. (auth)

24416 LONG SCINTILLATION COUNTER FOR PRECISE MEASUREMENT OF TIME OF FLIGHT AND IMPACT POSITION. Ghidini, B. (Bari Univ. (Italy). Istituto di Fisica); Mueller, K. (Bonn Univ. (F. R. Germany). Physikalisches Inst.); Eades, J.; French, B.; Mandelli, L.; Novach, F.; Picciarelli, V. (European Organization for Nuclear Research, Geneva (Switzerland)); Bailey, J.; Edwards, M.; Smith, I. L. (Science Research Council, Daresbury (UK). Daresbury Lab.). Nucl. Instrum. Methods; 125: No. 3, 357-363(15 Apr 1975).

Plastic scintillator counters made of long slabs (200 × 20 cm^2) of different thickness have been tested with 120 cm long plexiglas light guides coupled to 58 AVP photomultipliers. The accuracies achieved in measuring the time of flight of 600 MeV/c protons, which hit the counter at different distances from the photomultiplier, range from 350 to 450 ps fwhh. The impact position of the particles is determined along the counter by the time difference, as measured from the two opposite ends, with an accuracy ranging from 4.5 to 5.5 cm fwhh. (auth)

Radiometric Instruments

Refer also to abstract 24397.

24417 (AEC-tr-7314, pp 17-22) PROBLEM OF THE USE OF MULTIPLE SCATTERING OF β-RADIATIONS IN THE MEASUREMENT OF FILM THICKNESS. Mashinin, V. A.; Pravikov, A. A. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The sensitivity of the β scattering method for measuring film thickness is calculated. The measurement of film thickness by β scattering seems to be applicable only for heavy materials having reflection coefficients higher than 0.2 to 0.5. (WHK)

24418 (AEC-tr-7314, pp 22-26) MEASUREMENT OF FILM THICKNESS BY COMBINED SOURCES. Pravikov, A. A. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Formulas are developed that are suitable for calculating the error characteristics of beta-backscatter thickness gages using multiple radioactive sources. The use of multiple sources increases the range of film thickness that can be measured with one instrument. (TFD)

24419 (AEC-tr-7314, pp 26-34) ANALYSIS OF ERRORS IN RADIOISOTOPE EQUIPMENT. Kreindlin, I. I.; Matveev, L. V. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

All the errors in radioisotope equipment are analyzed including the statistical error, apparatus error, and methodical error. The analysis is carried out in a general manner, i.e. its results can be applied to equipment used for various purposes. (WHK)

24420 (AEC-tr-7314, pp 34-42) INFORMATION CHARACTERISTICS OF RADIOISOTOPE EQUIPMENT. Matveev, L. V. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

In the development and exploitation of radioisotope equipment, a number of problems arise. In order to solve these problems, it is necessary to use the theory of information. The error of the measurements with radioisotope equipment depends on the measurement time (the constant of integration). With the increase in measurement time, the statistical error decreases. However, the dynamic error increases since information on short-time changes of the measured parameter is lost. A reverse process takes place with the decrease of the measurement time. Therefore, the apparatus measurement time should be chosen while considering these factors. This problem is closely related to the control of the accuracy of the apparatus and the correction of its error. (WHK)

24421 (AEC-tr-7314, pp 114-124) INTRODUCTION OF CORRECTIONS FOR THE "DEAD TIME" OF A MULTICHANNEL ANALYZER IN ACTIVATION ANALYSIS BY SHORT-LIVED ISOTOPES. Nikolaenko, O. K.; Sidorov, A. V.; Shtan, A. S. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

It is frequently necessary to introduce corrections for the dead time of the analyser on using instrumental activation analysis for the simultaneous determination of a number of elements, which is usually carried out with a multi-channel amplitude analyser. The value of this correction may be quite high in the case of the analysis of strongly activated substances and in the determination of small concentrations of elements where the analyzed sample must be irradiated with an intense neutron flux. Procedures and results are described. (WHK)

24422 (AEC-tr-7314, pp 159-165) DISCRETE RADIOISOTOPIC METER FOR ICING INTENSITY. Biryukov, V. N.; Emel'yanov, S. S.; Kreindlin, I. I.; Savitsku, L. G. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

At present, equipment for signaling the start and the end of icing has been manufactured and well developed. The output signal of this equipment is used for the automatic connection of aircraft anti-icing systems. In many cases, especially in the case of the necessity for automatic regulation of anti-icing systems, the information obtained from this equipment is insufficient because it does not include data on one of the basic characteristics of the icing zone, namely the rate of ice growth (icing intensity). A radiometric meter which is more accurate than the conventional meters for measuring the icing intensity is described. (WHK)

24423 (AEC-tr-7314, pp 256-261) APPARATUS COMPLEX FOR THE AUTOMATION OF ACTIVATION ANALYSIS. Ivanets, V. N.; Ivanov, I. N.; Talanov, B. P.; Shtan, A. S. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

For the general application of the activation method in industry and in scientific research, a complex of sub-assemblies and block diagrams was developed, which is intended to coordinate the work of all the components and automatically execute all the analytical operations up to printing out the data. The complex is, to a considerable extent, universal and is intended for the construction of automatic activation analysis systems of diverse purposes and complexities. (WHK)

24424 (AEC-tr-7314, pp 262-265) NEUTRON MONITOR USING INTEGRATING RC CIRCUITS. Nikolaenko, O. K.; Komissarov, V. V.; Shtan, A. S. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The comparison of different methods for the control of neutron yields in the analysis of multicomponent samples with the use of neutron generators shows that the most acceptable methods are the methods of simultaneous irradiation of both specimen and standard and integration of the counting velocity of the neutron monitor by RC-circuits. This is so because only by that method is it possible to correctly allow for the dependence of the induced

activity on the half-life period of the activation product for a changing neutron yield. The disadvantages of the first method are the difficulties encountered in the preparation of standards and the necessity for interpreting their complex spectrum which brings about a complementary error and increases the duration of analysis. In the second method, it is necessary to apply a neutron data unit, the output signal of which is strictly proportional to the neutron flux. The construction of such a data unit presents certain difficulties in the use of pulse neutron generators. If the generator has a stationary accelerating voltage, the second monitor is preferable. Operation and performance of a neutron monitor for this purpose is described. (WHK)

24425 (AEC-tr-7314, pp 336-341) FIELD SCALER PM-1 WITH AN ELECTROMECHANICAL COUNTER AND A STOPWATCH. Kreindlin, I. I.; Novikov, V. S.; Pravikov, A. A.; Razumikhin, N. G.; Setyukov, L. I. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

In the performance of soil-land reclamation, building, hydrotechnical and other works, radioisotope equipment, specifically designed for field conditions, is being increasingly applied. A scaler, PM-1, with an electromechanical counter and a stopwatch has been developed in VNIIRT and is destined to measure the counting velocity of pulses from diverse detectors under field conditions. The apparatus is constructed with dust-splash-proof materials and allows normal work at a surrounding air temperature of −10 to 50°C. A potential 12 V accumulator feeds the apparatus. The basic parameters of the PM-1 apparatus are given. The apparatus is used in the general assembly of radioisotope hygrometer−densimeter vans. (WHK)

24426 (AEC-tr-7314, pp 342-346) RECORDING SYSTEM FOR X-RAY RADIOMETRIC APPARATUS. Varvaritsa, V. P.; Kozlov, O. V.; Lavrent'ev, Yu. D.; Mamikonyan, S. V.; Isaev, V. S. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The recording system described is intended for use in a two-channel apparatus for the analysis of material composition by the x-ray-fluorescence method. The recorder has the following features: 1) a relatively small counting velocity, up to a few tens of thousands of pulses per second; 2) a relatively large measuring time, up to 20-30 min; 3) a high measuring time stability (instability must not exceed 0.05 - 0.1% for 8 hours work); 4) counting capacity of 5 to 6 decade discharges; and 5) absence of the necessary indication of new discharges. (WKH)

24427 (AEC-tr-7314, pp 358-372) FEATURES FOR THE DETERMINATION OF THE ECONOMIC EFFECTIVENESS OF RADIOISOTOPE INSTRUMENTS. Purtova, M. I.; Sokolov, Z. I.; Goncharova, A. A. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The basic economic characteristics for the introduction of radiation technology are evaluated by economic factors which are affected by a given aspect of radiation technology, namely: 1) decrease in consumption of raw and other materials (fuel, components, analysis, etc.); 2) increase in efficiency (machines, apparatus); 3) economy of production costs; 4) reduction of wastes; and 5) improvement of production quality. Mathematical expressions for calculating the economical efficiency of radioisotope gages are given and examples are detailed. (WHK)

24428 NEUTRONIC FLOW METER. Radkowsky, A. (to U. S. Energy Research and Development Administration). US Patent 3,885,156, G01t1/16, 20 May 1975. Filed Date 23 May 1974, 7p.

PAT-APPL-472,931.

A neutronic flow meter which uses a neutron source surrounded by a moderator at cryogenic temperatures and neutron detectors located upstream and downstream of the source to measure the fluid flow rate through a pipe and alternately a ships speed is described. (auth)

24429 CALCULATION OF THE SCALE OF RADIOISOTOPE DEVICE USED FOR MEASURING THE SURFACE DENSITY OR THICKNESS OF SHEET MATERIAL. Prilipko, I. T. Meas. Tech.; 17: No. 12, 1836-1839(Dec 1974).

Translated from Izmer. Tekh.; No. 12, 26-28(Dec 1974).

The basic design, radiation attenuation equations, and method for calibration of β absorption radiometric gages for measuring surface density and thickness of paper and cardboard, textiles, polymer films, and rolled metal sheets are presented and discussed. (WHK)

24430 SCALING DEVICE FOR RADIOISOTOPE COATING THICKNESS GAUGES. Pankratov, V. I.; Vaskovskii, B. G. Meas. Tech.; 17: No. 12, 1840-1842(Dec 1974).

Translated from Izmer. Tekh.; No. 12, 28-30(Dec 1974).

The scaling device is intended for use with radioisotope thickness gauges which involve a balanced principle of measurement, i.e., the scaling device receives a measurement signal corresponding to the deviation of the mass of base plus coating from the nominal value, and an additional signal from a meter monitoring the base in a two-channel mode of operation. The scaling device is connected to the output of the measuring circuit and performs the following operations on the signal or signals: elimination of channel interaction when there are two or more channels, algebraic summation, and also division and multiplication. (WHK)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

24431 (SAND-75-5251) PROCESS OPTIMIZATION OF RADIATION-HARDENED CMOS INTEGRATED CIRCUITS. Derbenwick, G. F.; Gregory, B. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 8p. (CONF-750703-4). Dep. NTIS $4.00.

From IEEE annual conference on nuclear and space radiation effects; Arcata, California, USA (14 Jul 1975).

Results are presented of an investigation on process optimization for radiation-hardened CMOS integrated circuits. The aluminium gate CMOS technology was studied, and research was divided into the areas of low temperature processing (pre-oxidation conditions and clean, rinse, and post-oxidation photoresist steps) and high temperature processing (oxidation, annealing, and sintering). (WHK)

Miscellaneous Instruments

Refer also to abstracts 24279 and 24726.

24432 (TID/SNA-1604) DESIGN CRITERIA INSTRUMENTATION AND CONTROLS, NERVA PROPELLANT FEED SYSTEM TESTING FACILITIES. (Aerojet-General Corp., Sacramento, Calif. (USA)). 6 Jun 1963. 23p. Dep. NTIS $4.25.

The instrumentation parameters are listed and cost estimates given for recording data from the following types of transducers: strain gages, resistance temperature gages, thermocouples, flow rate meters and speedometers, valve position indicators, hf meters, and distance detectors. (WHK)

24433 HYDROGEN DETECTOR FOR SODIUM COOLED REACTORS. Roy, P.; Rodgers, D. N. (to U. S. Energy Research and Development Administration). US Patent 3,886,444, G01n27/00; G01n7/10, 27 May 1975. Filed Date 7 Feb 1974, 7p.

PAT-APPL-440,627.

An improved hydrogen detector for use in sodium cooled reactors is described. The improved detector basically comprises a diffusion tube of either pure nickel or stainless steel having a coating on the vacuum side (inside) of a thin layer of refractory metal, e.g., tungsten or molybdenum. The refractory metal functions as a diffusion barrier in the path of hydrogen diffusing from the sodium on the outside of the detector into the vacuum on the inside, thus by adjusting the thickness of the coating, it is possible to control the rate of permeation of hydrogen through the tube, thereby providing a more stable detector. (auth)

24434 LINEAR COUNTING-RATE CIRCUIT WITH CONSTANT STATISTICAL PRECISION. Jones, A. R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Instrum. Methods; 126: No. 2, 313-315(1 Jun 1975).

The circuit has an output current linearly related to the input pulse repetition rate over three decades. At low rates, the smoothing time constant increases to maintain constant statistical precision. (auth)

24435 SEPARATION OF ^{3}He GAS FROM ARGON USING A SIMPLE CYCLE-CONTROL CIRCUIT. MacLeod, A. M.; Hendry, J. M. (Glasgow Univ. (UK). Dept. of Natural Philosophy). Nucl. Instrum. Methods; 126: No. 2, 189-191(1 Jun 1975).

A semi-automatic apparatus and technique for the separation of ^{3}He from argon are described. The electronic control unit for the apparatus involves a multivibrator of independently variable mark and space times, and can be applied to other switching uses. (auth)

24436 TRANSIENT RECORDER-CAMAC DATAWAY INTERFACE MODULE. Toeroek, I. (SEE CODE- 1910825 Commission of the European Communities, Ispra (Italy). Joint Nuclear Re-

search Center). Nucl. Instrum. Methods; 126: No. 1, 109-114 (15 May 1975).

A single-width CAMAC module has been developed for control and readout of a Biomation type 8100 transient recorder. The module can perform two different types of readout: a programmed stop-mode block-transfer, and a flag-testing (handshake) mode. By means of the X response it is detected if the 8100 is not powered. (auth)

24437 FINITE CHANNEL WIDTH AND THE ANALYSIS OF EXPERIMENTAL DATA. Ponczek, R. L.; Castro Faria, N. V. de (Pontificia Universidade Catolica do Rio de Janeiro (Brazil), Instituto de Fisica); Guimaraes, A. P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nucl. Instrum. Methods; 126: No. 1, 125-127 (15 May 1975).

The distortion introduced in the data accumulated in a multichannel analyzer due to the finite width of the channels is easily taken into account in the analysis, when the function describing the phenomenon is known and can be integrated analytically over the channel width. This idea was applied to the analysis of simulated Lorentzian lines, i.e., lines with a priori known parameters. The parameters derived from least-squares fits using (a) a Lorentzian function and (b) the integrated function were compared with the original values for different ratios of channel width to peak width. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

24438 (AEC-tr-7314) RADIATION TECHNOLOGY. Translation of Radiats. Tekh.; No. 5, 1-381(1970). 387p. Dep. NTIS $10.60.

Separate abstracts have been prepared for 47 of the 52 papers included. The remaining 5 papers are not in the subject scope of NSA. (TFD)

For abstracts of individual papers see: 24123–24126, 24144, 24168, 24169, 24265, 24320–24323, 24361, 24385, 24386, 24390–24393, 24417–24427, 24451–24457, 24462–24464, 24467, 24622, 25079, 25164–25166, and 25174.

Isotope Separation (Industrial)

Refer also to abstract 24277.

24439 (ERDA-1543(DR)) ENVIRONMENTAL STATEMENT: EXPANSION OF U. S. URANIUM ENRICHMENT CAPACITY. (Energy Research and Development Administration, Washington, D. C. (USA)). Jun 1975. 449p. W. H. Pennington, Office of Asst. Admin., Wash., DC. Free.

The current production capacity for enriching uranium for commercial nuclear power plants is fully committed to existing and currently planned domestic and foreign reactors. The postulated expansion required to support nuclear power growth through year 2000 is eleven enrichment plants, each of which is equivalent in capacity to an existing U. S. uranium enrichment plant. This Statement assesses the reasonably foreseeable environmental, social, economic, and technological costs and benefits of this expansion along with the reasonably available alternatives to such expansion. The environmental impacts of construction and operation of the postulated eleven additional plants would involve the commitment of approximately 8,000 acres of land for plant sites and power transmission lines. The major impact associated with the expansion will be due to the production of power required to operate the enrichment plants. This impact will be minimal since it is anticipated that the majority of the new plants will use the gas centrifuge process which requires only about ten percent as much electricity as the currently used gaseous diffusion process. The radiation dose to population living within 50 miles of the plants is estimated to be 0.05 percent of the dose received from natural radiation background. Alternatives considered included no expansion of enrichment capacity; limiting enrichment services to U. S. requirements; alternate ratios of diffusion and centrifuge plants; and alternate tails assays. (LK)

24440 (INIS-mf-1683) AN INVESTIGATION OF CHEMICAL PROBLEMS ASSOCIATED WITH THE GS PROCESS FOR HEAVY WATER PRODUCTION. Annual Report of Work Carried Out Under Atomic Energy of Canada Ltd. Contract No. 1851. Webb, John; Leffek, K. T. (Dalhousie Univ., Halifax, Nova Scotia (Canada). Dept. of Chemistry). Aug 1974. 52p. INIS.

Results for the analysis of CAM filters received in the past year are reported. The concentration of adsorbable organics in Port Hawkesbury raw water seems to decrease in the winter months. The organics level in the process water remains lower and fairly constant. The efficiency of the extraction apparatus used with CAM filters was significantly increased by raising the extraction temperature for each solvent. Preliminary results obtained from the new sampling and extraction program, the O-CA method, are given. Insufficient data are available for the establishment of trends but the increased efficiency of the method over the CAM method is noted. Both CAM and O-CA extracts were characterized by UV spectroscopy. For the former no correlation was established between concentration and optical density for solutions of the extracts. For the latter, a linear correlation seems to exist. The accumulation of more data will confirm or deny the existence of this relationship. UV spectroscopy was also useful for the evaluation of drying techniques for the extracts. Drying by means of a stream of nitrogen appears to be preferable to drying by rotary evaporation distillation. Three techniques were evaluated for their application to the separation of extracts into groups of components. Ultrafiltration was found to be useful for rough separations according to molecular weight. Substances with the following molecular weight ranges were found for an ethanol extract: 10% >10,000, 40% 500–10,000, ~50% <500. Application of gel chromatography on Sephadex G-25 resulted in poor separation of an ethanol extract. Only two components were resolved and adsorption processes were indicated. Variation of solvent composition, pH, and ionic strength did not improve the resolution. Chromatography on Amberlite XAD-2 resin resulted in the quantitative separation of several ethanol extracts into ionic, acidic, basic and neutral fractions. The fractions were foam tested and in every case the fraction containing neutral organic compounds showed the greatest foaming activity. A quantity of the neutral fraction was isolated and subjected to mass spectroscopic analysis. Results were inconclusive. (auth)

24441 (KY-666) DISPOSAL OF HYDROGEN FLUORIDE AND FLUORINE BY GAS-LIQUID DISPERSION SCRUBBING. Story, A. J. (Paducah Gaseous Diffusion Plant, Ky. (USA)). 15 Sep 1975. Contract W-7405-eng-26. 18p. Dep. NTIS $4.00.

A gas–liquid dispersion scrubber was investigated as a method for removing hydrogen fluoride and fluorine from gas streams. Experimental results indicated that the scrubber was greater than 99 percent effective for hydrogen fluoride removal at various concentration levels up to six percent. It is postulated that the scrubber would also be effective at levels greater than six percent. Studies for fluorine removal showed that superficial velocity and fluorine inlet concentration are system variables which produce an interacting effect on the total fluoride in the outlet, and significant quantities of oxygen difluoride are formed at inlet concentrations greater than one percent fluorine. (auth)

24442 (NP-20525) SEPARATION OF NEON ISOTOPES BY A PLASMA CENTRIFUGE. James, B. W.; Millar, D. D.; Simpson, S. W. (Sydney Univ. (Australia). School of Physics). May 1975. 16p. (ER-88). Dep. NTIS (US Sales Only) $4.00.

Experimental results are presented of the separation of neon isotopes obtained in a plasma centrifuge. The results are consistent with the prediction of elementary equilibrium theory. (auth)

24443 (Y-887) SQUARE DUAL TEMPERATURE CASCADES AT TOTAL REFLUX. DeMarcus, W. C. (Oak Ridge Y-12 Plant, Tenn. (USA)). 27 Jun 1952. Contract W-7405-eng-26. 32p. Dep. NTIS $4.75.

Declassified 9 Nov 1973.

Two countercurrent isotope separation columns connected together and maintained at different temperatures are considered. Because of the temperature difference, the separation factors of the two columns will not be the same. The column with the smaller separation factor is used as a reflux unit in the dual temperature process and replaces the chemical refluxing equipment which would otherwise be necessary. Although the analysis is applicable to any two-phase countercurrent system, for purposes of clarity the phases are designated as amalgam and amine, respectively. The ratio of isotopic mole fractions at opposite ends of the columns is calculated assuming (1) the separation factors are not much greater than unity, and (2) the mole fractions of the isotopic species whose enrichment is sought is a small quantity. Tables are given to facilitate the calculation of the above ratio and also the height equivalent of a theoretical stage. (auth)

24444 USE OF CRITICAL PATHWAY MODELS AND LOG-NORMAL FREQUENCY DISTRIBUTIONS FOR SITING NUCLEAR FACILITIES. Waite, D. A.; Denham, D. H. (Battelle Pacific Northwest Labs., Richland, WA). pp 407-415 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

The advantages and disadvantages of potential sites for nuclear facilities are evaluated through the use of environmental pathway and log-normal distribution analysis. An exposure pathway diagram must be developed. This type of diagram helps to locate pertinent environmental media, points of expected long-term contaminant accumulation, and points of population/contaminant interface for both radioactive and non-radioactive contaminants. Confirmation of facility siting conclusions drawn from pathway considerations must usually be derived from an investigatory environmental surveillance program. How these basic principles apply to the actual siting of a nuclear facility is demonstrated for a centrifuge-type uranium enrichment facility as an example. A model facility is examined to the extent of available data in terms of potential contaminants and facility general environmental needs. A critical exposure pathway diagram is developed to the point of prescribing the characteristics of an optimum site for such a facility. Possible necessary deviations from climatic constraints are reviewed and reconciled with conclusions drawn from the exposure pathway analysis. Details of log-normal distribution analysis techniques are presented, with examples of environmental surveillance data to illustrate data manipulation techniques and interpretation procedures as they affect the investigatory environmental surveillance program. (auth)

Isotopic Power Sources

Refer also to abstract 24265.

24445 (BMI-X-656) FINAL REPORT ON PRODUCTION OF Pu-238 IN COMMERCIAL POWER REACTORS: TARGET FABRICATION, POSTIRRADIATION EXAMINATION, AND PLUTONIUM AND NEPTUNIUM RECOVERY. Pobereskin, M.; Langendorfer, W.; Lowry, L.; Farmelo, D.; Scotti, V.; Kruger, O. (Battelle Columbus Labs., Ohio (USA)). 31 Jan 1975. 210p. Dep. NTIS $13.50.

Considerable interest has been generated in more extensive applications of radioisotope thermoelectric generator (RTG) systems. This raises questions concerning the availability of ^{238}Pu to supply an expanding demand. The development of much of this demand will depend upon a considerable reduction in cost of ^{238}Pu. Two neptunia–zirconia–fuel target rods, containing four sections each of different NpO_2 concentrations, were irradiated in the Connecticut Yankee Reactor for approximately one year. Following irradiation both target rods were subjected to nondestructive examination. One rod was chosen for destructive testing and analysis. Post-irradiation chemical analyses included total Pu and Np, ppM ^{236}Pu/^{238}Pu, and Pu isotopic abundance. The results of these analyses and of electron microprobe analysis which provided the relative Pu concentration across the pellet diameters are tabulated. It was concluded that the feasibility of all operations involved in the production of ^{238}Pu by irradiation of $^{237}NpO_2$ targets in commercial nuclear power reactors was demonstrated and that the demonstration should be extended to a pilot-scale leading to installation of a full production capacity. (LCL)

24446 (DPST-75-128-7) ^{238}Pu FUEL FORM PROCESSES. Savannah River Laboratory Monthly Report, July 1975. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 25p. Dep. NTIS $4.00.

An empirical equation was developed to forecast neutron emission from fabricated fuel forms. Temperature, $^{16}O_2$ flow rate, and time are significant fabrication parameters. Increasing the shard heat-treatment temperature results in a rounding of shard surfaces and strengthening of the shard internal structure. Coarse shard-to-shard porosity is reduced as pressures are increased during hot pressing. The temperature threshold for helium bubble formation at grain boundaries of high-fired $^{238}PuO_2$ shards increases with decreasing grain size and increasing porosity. Hot-pressed $^{238}PuO_2$ pellets exhibited no deleterious microstructural changes due to helium release after storing for seven months followed by heating to 1600°C. Construction of the Plutonium Experimental Facility is underway. (auth)

24447 (MLM-2226) SUMMARY OF NEUTRON MEASUREMENTS FOR THE VIKING PROGRAM. Anderson, M. E. (Mound Lab., Miamisburg, Ohio (USA)). 15 Aug 1975. Contract E-33-1-GEN-53. 16p. Dep. NTIS $4.00.

The results of neutron measurements for ^{238}Pu-fueled, 683-W (thermal) capsules fabricated for the Viking Program (Mars Lander) are presented. These results include, for each capsule, the total neutron emission rate and neutron multiplication and, for one capsule, the neutron energy spectrum. A precision long counter was used for the neutron emission rate measurements and a single stilbene crystal for the neutron spectrum measurement. (auth)

24448 (ORNL-4045) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING SEPTEMBER 30, 1966. Lamb, E. (Oak Ridge National Lab., Tenn. (USA)). Nov 1966. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

Declassified 6 Sep 1973.

Properties of the curium fuel studied during this reporting period include the rate of helium released by the decay of curium oxide and the compatibility of two curium fuel forms with TZM. Fission-product development consisted of the synthesis and analysis of a cesium ceramic, determination of the thermal conductivity of $SrTiO_3$, and determination of the thermal coefficients of expansion of SrO and $SrTiO_3$. The fabrication of the curium fuel form, the fueling of the SNAP-11 generator, and the simulated lunar environmental test are described. (auth)

24449 RADIOACTIVE BATTERY. Deaton, R. L.; Silver, G. L. (to U. S. Energy Research and Development Administration). US Patent 3,884,718. H01m29/00. 20 May 1975. Filed date 19 Apr 1973. 11p.

PAT-APPL-352,827.

A radioactive battery is described that is comprised of a container housing an electrolyte, two electrodes immersed in the electrolyte and insoluble radioactive material disposed adjacent one electrode. Insoluble radioactive material of different intensity of radioactivity may be disposed adjacent the second electrode. If hydrobromic acid is used as the electrolyte, Br_2 will be generated by the radioactivity and is reduced at the cathode: $Br_2 + 2e$ equals $2\,Br^-$. At the anode Br^- is oxidized: $2Br^-$ equals $Br_2 + 2e$. (TFD)

24450 DOSE RATES TO A BYSTANDER FROM AN ARTIFICIAL HEART POWER SOURCE. Cross, F. T. (Battelle Pacific Northwest Labs., Richland, WA). Health Phys.; 29: No. 2, 350-352(Aug 1975).

Computations and measurements have been undertaken to help define the dose rates received by the population from an artificial heart recipient containing a ^{238}Pu power source. Two heterogeneous mathematical phantoms were used to represent the artificial heart recipient and the bystander. A ^{252}Cf source was used as a stand-in for plutonium in order to increase the range of neutron dose measurements and to decrease the experimental time. The average calculated photon and neutron dose rates received by the bystander phantom at head, legs, total body and trunk at various separations of the two phantoms at the beginning of the power source life are shown graphically. Multiplication factors to account for the ^{238}Pu impurity over the 10 yr design life of the artificial heart are considered. (UK)

Radiation Sources

Refer also to abstracts 24322, 24385, and 24398.

24451 (AEC-tr-7314, pp 86-93) INVESTIGATION OF THE SPECTRAL CHARACTERISTICS OF NEUTRON SOURCES BASED ON ^{238}Pu, ^{244}Cm, AND ^{252}Cf. Tyufyakov, N. D.; Shtan, A. S.; Yaskevich, V. S.; Kozlov, A. G.; Pavlovich, V. B.; Trykov, L. A.; Taypin, S. G. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Neutron spectra data are given for the neutron sources: ^{238}Pu + LiF; ^{238}Pu + Be; ^{244}Cm + Be; ^{244}Cm; and ^{252}Cf. (TFD)

24452 (AEC-tr-7314, pp 93-98) INVESTIGATION OF THE FORM OF NEUTRON BEAMS FROM ISOTOPIC NEUTRON SOURCES. Ponomarev, E. G.; Tyufyakov, N. D.; Shtan, A. S.; Yaskevich, V. S. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Since the thermal and slow neutrons necessary for neutron radiography are obtained by the moderation of fast ones, the neutrons will be distributed over the entire volume of the moderating medium which will be the source of thermal neutrons. The mode of this distribution depends on the characteristics of the source, the energy spectrum of the fast neutrons, and the type and dimensions of the moderator. Experiments were carried out to determine the effect of the following factors on the beam: moderator layer between the source and the bottom of the canal of the collimator; the diameter of the canal; the cadmium-plating of the collimator's walls; and the distance from the source to the moderator's boundary. The sources used were ^{238}Pu + Be, and ^{252}Cf. (TFD)

24453 (AEC-tr-7314, pp 151-159) SOME FEATURES OF THE CYLINDRICAL COLLIMATORS OF β-RADIATION. Kukharenko, I. V.; Mashinin, V. A. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

In the use of radioisotopes, the collimation of a flux of ionizing radiation is the principal method of forming a beam. The geometrical approach to the design of a collimator gives substantial errors since the radiation field is deformed due to the interaction of the radiation with the material of the collimator and the surrounding medium. This is particularly evident for the case of the collimation of β-rays due to the high value of the scattering cross section of β-particles at low angles. Measurements were carried out of the radiation field emerging from cylindrical collimators at different ratios of the diameter of the collimation orifice and for different collimator materials (plastic, Al, Cu and Pb). In the experiments a ^{90}Sr-^{90}Y source of the BIS-M type with an activity of about 5 mC; and a scintillation detector composed of a FEY (photomultiplier) and an anthracene crystal of dimensions 20 X 10 mm and a semiconductor silicon detector (DDR-$^{5}/_{2}$) with a window 5 mm diameter was used. The block diagram for the registering part of the equipment is shown. The energetic threshold of registration is 50 keV for the PPD (semiconductor detector) and 30 keV for the scintillation detector. The geometrical parameters of the collimator are characterized. (TFD)

24454 (AEC-tr-7314, pp 217-229) INVESTIGATION OF THE ROTATIONAL GAMMA-THERAPEUTIC APPARATUS RAD-1. Kondrashov, V. M.; Sul'kin, A. G.; Galina, L. S.; Emel'yanov,

V. T.; Petrov, G. G. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The rotational γ-therapeutic apparatus RAD-1 with a ^{60}Co source of 4000 Curie activity was introduced in the VNII (All-Union Instrument Research Institute) radiation technology in 1967. It is composed of a radiational head containing the radiation source, a strong stand, a medical table, a main and complementary control desks, lateral, back and arc centerings, remote devices, collimator for the removal of penumbra and a device for video call communication. The kinematic diagram of the apparatus allows the performance of rotational, sectorial and static irradiation of deeply located pathological regions. The design, operation, and performance parameters of the device are described. (TFD)

24455 (AEC-tr-7314, pp 230-236) INVESTIGATION OF TRANSPORTING EQUIPMENT WITH A GAMMA-THERAPEUTIC HOSE APPARATUS FOR INTERNAL CAVITY IRRADIATION. Komar, V. Ya.; Rimman, A. F.; Sul'kin, A. G.; Zhukovskii, E. A. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The investigation shows that the pneumatic transporter satisfies the basic requirements of transporting equipment of a hose apparatus for internal cavity irradiation. (TFD)

24456 (AEC-tr-7314, pp 237-245) GRAPH-ANALYTICAL METHOD FOR DEFINING THE FORM OF A COLLIMATOR FOR CONVERGENT IRRADIATION ON A SHORT RANGE GAMMA-THERAPEUTIC APPARATUS. Galina, L. S. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

A method is suggested for calculating the form of the collimator, the rotation radius of the source and the distance between the source and the surface, which provides the specified dose profile. (TFD)

24457 (AEC-tr-7314, pp 276-287) EXPERIMENTAL INSTALLATION FOR THE INVESTIGATION OF THE PARAMETERS OF NEUTRON GENERATORS WITH VACUUM TUBES. Kir'yanov, G. I.; Gusev, A. V.; Lyumikov, Yu. G.; Ermakov, N. A. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Neutron pulse generators constructed in VNIIRT have as a neutron source a vacuum accelerator tube with a spark deuterium ion source and a deuterium or tritium target. The small dimensions and the high neutron yield per pulse (10^8 to 10^9 neutron/sec) impose numerous requirements as regards the elements and blocks of the neutron generator which are usually composed of a neutron source, modulator, control desk, detection, and registration equipment. The basic feature of the neutron generator is the value of the neutron flux and consequently great attention is paid to the equipment and methods of investigation of the following parameters: neutron yield per pulse; average neutron flux; fluctuation of neutron yield per pulse; stability of the average neutron flux with time; and density of neutron flux and its distribution in space. The present work is dedicated to a description of an experimental installation for the investigation of parameters of neutron generators, with vacuum tubes, which is part of the laboratory equipment used in the investigation of neutron generators. (auth)

24458 (LA-6007-MS) SYSTEM CONTROL FOR THE MODULATED ^{252}Cf SOURCE "SHUFFLER". Stephens, M. M. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1975. Contract W-7405-ENG-36. 9p. Dep. NTIS $4.00.

The design and theory of operation of the control chassis for a ^{252}Cf nondestructive assay system are described. This system repetitively transfers a ^{252}Cf source from the irradiation region to a shielded position before measuring the delayed neutrons. The design criteria for the system were: rapid movement and precise positioning of the ^{252}Cf source, precise positioning of the sample, and very accurate timing of the irradiate and count cycles. To achieve these results crystal oscillators were used for timing, and stepping motors were used to position the sample and the source. (auth)

24459 ION-BEAM MASK FOR CANCER PATIENT THERAPY. Castle, J. G. Jr. (to U. S. Energy Research and Development Administration). US Patent 3,886,367. G21f1/00. 27 May 1975. Filed date 18 Jan 1974. 7p.

PAT-APPL-434,458.

An ion-beam mask has been provided for spatially distributing fast ions used to irradiate tumors so that the region near the Bragg peak receives a uniform radiation dose while the tissue at the point of entrance of the beam has a web of unirradiated volume to promote healing of the surface tissue following radiotherapeutic treatment of embedded tumors. (auth)

24460 MULTI-LAYER MONOCHROMATOR. Schoenborn, B. P.; Caspar, D. L. D. (to U. S. Energy Research and Development Administration). US Patent 3,885,153. G01t1/36. 20 May 1975. Filed date 20 Jun 1974. 15p.

PAT-APPL-481,421.

This invention provides an artificial monochromator crystal for efficiently selecting a narrow band of neutron wavelengths from a neutron beam having a Maxwellian wavelength distribution, by providing on a substrate a plurality of germanium layers, and alternate periodic layers of a different metal having tailored thicknesses, shapes, and volumetric and neutron scattering densities. (auth)

24461 "NEUTRON TURBINE" AS AN EFFICIENT SOURCE OF ULTRACOLD NEUTRONS. Steyerl, A. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). Nucl. Instrum. Methods; 125: No. 3, 461-469(15 Apr 1975).

A novel device for the efficient production of ultracold neutrons has been developed and installed at the FRM reactor at Munich. This so-called "neutron turbine" consists of a large rotating wheel with a large number of thin curved copper shells ("blades") along its circumference. The incident neutron spectrum in the velocity range of ~50 m/s is transformed to the velocity range ≲10 m/s by multiple total reflection from these moving blades. This is of particular interest for some ultracold-neutron transmission experiments and for neutron containment. The neutron spectrum provided by the turbine is consistent with the Maxwellian expectation. A value of ~45% was determined for the efficiency of the transformation of the neutron spectrum. As an example of turbine utilization the results of transmission measurements through a thin nickel film are discussed. (auth)

Design and Fabrication

Refer also to abstract 25175.

24462 (AEC-tr-7314, pp 266-275) DEVELOPMENT OF A PULSE NEUTRON GENERATOR FOR REACTOR RESEARCH. Kur'yanov, G. I.; Allakhverdov, A. Sh.; Gusev, A. V. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

In research institutes, the study of the properties of fast or thermal neutron reactors is carried out on assemblies with the application of different neutron sources. It became possible, with the appearance of sealed pulse neutron tubes of the NT-16 type, to make a portable neutron generator for placing in the reactor or assembly channels. The NGI-6 generator developed in VNIIRT has the following basic parameters: average neutron flux not less than 10^7 neutron/s; pulse succession frequency up to 20 Hz; duration of the high-volt pulse of the accelerating voltage 1.6 to 1.8 μs; duration of the neutron pulse ~1.5 μs; feeding line voltage 220 V, frequency 50 Hz; consumed power not more than 300 W; and general weight, 80 kg. (TFD)

24463 (AEC-tr-7314, pp 311-319) STABILIZED SPRING COUNTERBALANCES IN RADIATION EQUIPMENT. Sul'kin, A. G. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Stabilized spring counterbalances to facilitate the movement of heavy parts such as radiation heads with gamma sources, x-ray tubes in shielding jackets, etc, are described. (TFD)

24464 (AEC-tr-7314, pp 320-330) STABILIZED SPRING COUNTERBALANCES WITH A SPIRAL COMPENSATOR. Sul'kin, A. G. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Stabilized spring counterbalances with spiral compensators to facilitate the movement of heavy parts such as radiation heads and x-ray tubes are discussed. (TFD)

24465 USE OF HEAVY METAL INSERTS TO MODIFY THE SPECTRUM OF NEUTRONS PRODUCED BY A NEUTRON HOWITZER. Cox, A. J.; Cleave, C. (Univ. of Aston, Birmingham, Eng.). Int. J. Appl. Radiat. Isot.; 26: No. 6-7, 430-432(Jun 1975).

Spectral measurements of the neutron beams produced by neutron howitzers show that there is a large fast neutron component in the neutron spectrum which would reduce the spatial resolution obtainable in any thermal neutron radiograph. In an attempt to reduce this fast neutron component while attenuating the thermal neutron flux as little as possible various axial inserts of lead, copper and iron were placed into the howitzer. The fast neutron spectra and the thermal neutron fluxes obtained for the various metal inserts are given. (UK)

24466 PRODUCTION OF ULTRACOLD NEUTRONS BY THE METHOD OF ROTATING FLAT NEUTRON MIRRORS. Kashou-

keev, N. T.; Stanev, G. A.; Ianeva, N. B.; Mirtcheva, D. S. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). Nucl. Instrum. Methods; 126: No. 1, 43-48(15 May 1975).

A mechanical generator has been built for ultracold neutron production by the method of multiple reflexions from rotating flat neutron mirrors. Relations were derived which describe the slowing down of neutrons by the proposed system. Using the equations obtained computer calculations were performed in order to choose the parameters and modes of operation. Preliminary experimental results are presented. (auth)

Industrial Uses

Refer also to abstract 25166.

24467 (AEC-tr-7314, pp 373-381) MATHEMATICAL STUDIES OF THE ECONOMICAL EFFECTIVENESS OF RADIOISOTOPE NEUTRALIZERS. Purtova, M. I.; Smirnova, Z. M.; Osinkina, G. D. May 1975. Translated from Radiats. Tekh.; No. 5, (1970). In radiation technology.

Results of investigations carried out for the determination of the economical suitability of introducing radioactive electrostatic charge eliminators in polygraphic, textile, and rubber industries are presented. (TFD)

LIFE SCIENCES

Refer also to abstracts 25176 and 25177.

24468 (ANL-75-30) DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH ANNUAL REPORT, 1974. Rosenthal, M. W. (ed.). (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 271p. Dep. NTIS $7.60.

Separate abstracts were prepared on 5 sections of the report. A list is included of 67 publications during the period covered by the report.

For abstracts of individual sections see: 24477, 24492, 24495, 24513, and 24514.

24469 (COO-2486-341) ANNUAL REPORT FOR PERIOD ENDING 30 APRIL 1975. Friedell, H. L. (Case Western Reserve Univ., Cleveland, Ohio (USA). Dept. of Radiology). 15 May 1975. Contract AT(11-1)-2486. 194p. Dep. NTIS $12.75.

Progress is reported in studies on radiation physics, radiation biochemistry, and cellular radiobiology. A list is included of 26 publications during the period that report the results of the studies. (CH)

Radiation Effects on Biochemicals

Refer also to abstract 24171.

24470 (COO-3243-4, pp 10-116) RADIOLOGICAL PHYSICS. 1975.

In annual report on research project, October 1, 1974–September 30, 1975. (Columbia Univ., New York (USA). Radiological Research Lab.).

Methods used for the dosimetry of monoenergetic neutrons in rats yielded information on the gamma dose and dose received from scattered radiation during neutron beam exposure. Results are reported from studies on the effects of neutron irradiation on the induction of somatic mutations in Tradescantia and the induction of chromosome aberrations in root tip cells of Vicia faba and Allium cepa. The neutron and photon (x and gamma) tissue kermas in free air and absorbed dose in a tissue-equivalent phantom were measured for four energies of monoenergetic neutrons (15.1, 5.5, 2.1, and 0.67 MeV) and a ^{252}Cf source of fission neutrons. Calibrations were made using a ^{137}Cs gamma source. The accuracy of the various dosemeters used is discussed. An apparatus is described that was constructed for irradiating mammalian cells with beams of charged particles. Methods for the microdosimetry of charged particles and monoenergetic photons (x and gamma) are discussed in detail. (CH)

24471 CONTRIBUTIONS CONCERNING RADIOSENSITIVITY PROFFERED BY THE BASIC SCIENCES TO CLINICAL RADIATION THERAPY. Caputo, A. (Istituto Regina Elena per lo Studio e la Cura dei Tumori, Rome). pp 5-15 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

Basic concepts of radiosensitivity are reviewed. Some topics discussed are: probability of lethal injury as a dose dependent function; mutations resulting from radiation damage to DNA; relation of cell radiosensitivity to chromosome volume; relation of molecular structure of DNA to relative radiosensitivity of the organism; repair replication of DNA following uv and x irradiation of Escherichia coli and mammalian cells; and relation of the cell cycle to radiosensitivity. (HLW)

24472 BIOLOGICAL IMPLICATIONS OF DNA IRRADIATION DAMAGES. Caputo, A.; Frigola, A.; Zupi, G. (Istituto Regina Elena per lo Studio e la Cura dei Tumori, Rome). pp 19-63 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

Implications of radiation damage to DNA are reviewed under the following headings: changes of molecular structure of irradiated DNA; DNA as the main target for lethal or sublethal radiation effects; mechanism of damage production by ionizing radiation; structural damages produced by uv radiation; radio-induced modification of the native state of DNA-protein complexes; radiation effects on DNA synthesis; and biological consequences stemming from irradiation damaged DNA. (HLW)

24473 RADIOSENSITIVITY IN SUBMICROSCOPIC ORGANISMS. Alper, T. (Hammersmith Hospital, London). pp 81-93 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

The following topics are reviewed: inactivation of dry subcellular particles; modification of response of dry subcellular particles; subcellular particles in suspension or solution; and possible implication of effects on oligomeric proteins. (HLW)

24474 VARIATION OF RADIOSENSITIVITY AND RECOVERY FROM RADIATION EFFECTS IN GENETIC STRUCTURES. Howard-Flanders, P. (Yale Univ., New Haven). pp 101-114 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

The total number of radiation damages in the DNA of human diploid G_1 cells produced by x-irradiation in oxygen appears to be about 2,000 per 100 rads (2,000 to 6,000 per D_0 for inactivation doses ranging from 100 to 300 rads). As residual damage in the DNA of the descendents of surviving cells is almost undetectable by present methods (the exception being rare mutations), it appears that virtually all significant radiation damages are corrected by repair enzymes in surviving cells. The lethal events may represent a failure to achieve complete reconstruction of chromosomal DNA. Most single-strand breaks are repaired rapidly. Two-strand breaks and damaged bases are repaired in slower processes. Since about thirty two-strand breaks per cell are produced per 100 rads, most are presumably repaired. Base damages appear to be repaired by excision or by recombinational repair, the latter being a process taking place after DNA replication (postreplication repair) and involving genetic exchanges between sister DNA duplex molecules. There may be opportunities to influence postreplication repair differentially in slow as compared to rapidly growing cell populations. (auth)

Radiation Effects on Cells

Refer also to abstracts 24470, 24471, 24474, 24492, and 24508.

24475 (COO-3243-4) ANNUAL REPORT ON RESEARCH PROJECT, OCTOBER 1, 1974–SEPTEMBER 30, 1975. Rossi, H. H. (Columbia Univ., New York (USA). Radiological Research Lab.). 1975. Contract AT(11-1)-3243. 254p. Dep. NTIS $7.60.

Separate abstracts were prepared for three sections of the report. (CH)

For abstracts of individual sections see: 24470, 24476, and 24494.

24476 (COO-3243-4, pp 155-242) RADIOBIOLOGY. 1975.

In annual report on research project, October 1, 1974–September 30, 1975. (Columbia Univ., New York (USA). Radiological Research Lab.).

The effects of metridazole and nitroimidazole on the survival time of cultured hamster cells following exposure to various doses and dose rates of ^{60}Co gamma radiation or neutrons were studied. Both were found to increase the radiosensitivity of the cells. Data are included on the modifying effects of neutron spectra, energy levels, LET, OER, dose, and dose fractionation schedules on the gamma and neutron sensitivity of cultured hamster cells. Studies on the sensitivity of cultured hamster cells and normal liver and hepatoma cells to hyperthermia and hypoxia, with and without the added effects of x irradiation showed that heat treatment at 43^0C enhanced the radiosensitivity of the cells, with hypoxic cells being the most sensitive. A system was developed for the study of radioinduced carcinogenesis in cultured hamster embryo cells. Preliminary data are presented on the dose response relationships for transformation following exposure to x radiation on neutrons. (CH)

24477 (ANL-75-30, pp 209-218) MAMMALIAN CELL BIOLOGY. Elkind, M. M. 1975.

In Division of Biological and Medical Research annual report, 1974. (Argonne National Lab., Ill. (USA)).

Studies of the action of N-ethylmaleimide (NEM), as an inhibitor of repair of x radioinduced injuries were extended from synchronous Chinese hamster cells to synchronous human HeLa cells. These studies showed a similar mode of action in both cell types lending support to the notion that conclusions may be extracted from such observations that are of fairly general applicability to mammalian cells. Radiation studies with NEM are being extended to hypoxic cells to inquire if NEM is effective relative to oxygen-independent damage. Observations relative to survival, DNA synthesis, and DNA strand elongation resulting from the addition products to DNA when cells were exposed to near uv in the presence of psoralen were extended. (CH)

24478 (ORO-747) EFFECTS OF FALLOUT RADIATION ON CROP PRODUCTION. Killion, D. D.; Constantin, M. J. (UT-ERDA Comparative Animal Research Lab., Oak Ridge, Tenn. (USA)). 3 Jul 1975. 40p. Dep. NTIS $4.00.

The vulnerability of selected food crops to radioactive fallout as affected by radiation dose, dose rate, kind of radiation, plant species, developmental stage, and postirradiation interval was studied. Data are presented on barley, wheat, soybeans, corn, potatoes, alfalfa, and rice. Results showed that morphological development influenced radiosensitivity of the plants in terms of seed or grain yield, and high radiation dose rates were more damaging to plants than low dose rates. Beta radiation was equivalent to gamma radiation for specific indices of damage. Annual plants showed sublethal damage at maturity but damage in perennials sometimes did not appear for several years. (CH)

24479 INDUCED RADIATION RESISTANCE IN CELL CULTURES OF CHINESE HAMSTER CELLS: INDUCTION AND MANNER OF RESISTANCE. Keusch, F.; Riehle, I.; Fritz-Niggli, H. (Univ., Zurich). Experientia; 31: No. 7, 844-846(15 Jul 1975). (In German)

Mutations-induction followed by selection is a suitable method for developing a cell line with resistance to low doses of x rays. In comparison with the original cell line, the derived resistant line is characterized by an enhanced variability of the chromosome number, and no higher level of cellular repair, limited to the two repair types described. (auth)

24480 BIOLOGICAL AND CLINICAL BASIS OF RADIOSENSITIVITY. Friedman, M. (ed.). American Lecture Series Publication No. 924. Springfield, IL; Charles C Thomas (1974). 678p. (CONF-711036-). $49.50.

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971).

Separate abstracts were prepared for the 24 chapters of the book. A subject index and an appendix on an experiment on induced DNA synthesis in cancer cells are included. (HLW)

For abstracts of individual chapters see: 24471-24474, 24481-24491, 24505-24511, 24541, and 24542.

24481 DNA AND CANCER BIOLOGY: ROLE IN RADIATION AND DRUG SENSITIVITY, CARCINOGENESIS AND MUTATIONS. Yielding, K. L. (Univ. of Alabama, Birmingham). pp 64-74 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

The DNA excision repair mechanism is an important factor in the resistance exhibited by tumor cells toward both x rays and alkylating agents as demonstrated by the fact that the chemical alterations to cellular DNA caused by these agents are substrates for the repair enzymes. Furthermore, experiments performed in our laboratory demonstrate that: tumor sensitivity to alkylating agents and x-ray can be increased by inhibition of the repair process, and there is a suggestion that this sensitization can be achieved with some degree of selectivity, thereby improving the balance of sensitivities between tumor and normal tissue. Other work has shown that cocarcinogens probably act by preventing repair of carcinogenic damage to the DNA genome. The possibility has also been raised that mistakes made during repair synthesis might be responsible for some genetic diversity and for the mutations which arise in resting cells. (auth)

24482 RADIOSENSITIVITY OF HUMAN CELLS: SOME GENERALIZATIONS. Andrews, J. R. (Georgetown Univ. and Veterans Hospital, Washington, DC). pp 121-140 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

Basic radiobiological mechanisms are reviewed. Some topics discussed are: dose-response relationships for human cancer cells; radiotherapy of Hodgkin's disease; radiation injuries of normal tissues; repair of radiation injuries in relation to dose, LET, and oxygen; and computer simulation of radiotherapeutic and radiobiologic information. (HLW)

24483 POPULATION DISTRIBUTION IN TUMORS AND NORMAL TISSUES: A GUIDE TO TISSUE RADIOSENSITIVITY. Berry, R. J. (Medical Radiobiologist United Oxford Hospitals). pp 141-155 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C. Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

There is evidence that much of the apparent radiosensitivity or radioresistance of different normal tissues can be explained by differences in the distribution of their cell populations through the various phases of their intermitotic cycle (or cell cycle), and without any underlying differences in their inherent radiosensitivity stage-for-stage in the cell cycle. Evidence from studies of cell proliferation kinetics in rodent tumors, and to a lesser degree from human tumors, suggests that the average intermitotic time among proliferating cells is shorter in tumors than in the normal tissues from which the tumors arose. The major exception to this general rule is tumors arising in the gastrointestinal tract and bone marrow, where the normal tissue is proliferating at a nearly flat-out rate merely to replace the everyday loss of differentiated or functional cells. If a differential can be maintained so that the rate of cell proliferation in a tumor is more rapid than in its contiguous normal tissue throughout a fractionated course of irradiation, there will be a selectively greater destruction of tumor cells than of cells of the normal tissue. (auth)

24484 CLINICAL SIGNIFICANCE OF CELL SURVIVAL CURVES. Nias, A. H. W. (Belvidere Hospital, Glasgow). pp 156-169 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

The large variation in the radiosensitivity of tumors found in clinical practice is not reflected in the narrow range of numerical values of radiosensitivity found when appropriate cells are assayed in survival curves. The significance of such survival curves is discussed and it is suggested that certain information can be of direct use to clinical radiotherapy, although the usual warning must be given against extrapolating from laboratory data obtained in vitro and in animals. Specific examples of the application of data from cell survival curves include the variability of relative biological efficiency in neutron therapy and the possible variability of oxygen enhancement in x-ray therapy, with size of fraction dose over the range customarily used in radiotherapy. (auth)

24485 IMPORTANCE OF VASCULARITY, TUMOR BED, AND OTHER GENERAL ASPECTS IN RADIOSENSITIVITY. Casarett, G. W. (Univ. of Rochester, NY). pp 181-202 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

Variables influencing radiosensitivity of tumors are discussed with regard to initial radiosensitivity of parenchymal and vascular cells and tissues and radioinduced changes altering subsequent radiosensitivity of parenchymal cells. An ideal scheme for dose-time relationships in fractionated irradiation is described. (HLW)

24486 ELECTRON MICROSCOPE STUDIES OF METHOTREXATE AND RADIATION EFFECTS IN HUMAN SQUAMOUS CELL CARCINOMA OF THE MOUTH. De Martino, C. (Istituto Regina Elena per lo Studio de las Cura dei Tumori, Rome). pp 219-252 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

Serial biopsy specimens from two squamous cell carcinomas of the mouth were studied by electron microscopy. This report described the ultrastructural changes in the cells produced by treatment with methotrexate followed by irradiation. The main ultrastructural findings after treatment are: numerous autophagic lysosomes and residual bodies are visible in the cytoplasm of the tumor cells; mitochondria are swollen. The mitochondrial cristae are distorted and disrupted, and mitochondrial matrix disappears; the nucleolus shows a series of morphological changes such as development of a compact nucleolus, aggregation of granular elements, atrophy, dissolution and fragmentation of the nucleolar mass; infiltration of lymphocytes, granulocytes and macrophages in the tumor. The significance of these ultrastructural findings is discussed. (auth)

24487 CELL KINETIC STUDIES AS RELATED TO RADIOSENSITIVITY. Regeneration Differences Between Normal and Malignant Tissues. Lamerton, L. F. (Inst. of Cancer Research, Sutton, Eng.). pp 263-273 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

Cell kinetic factors that determine the rate of recovery of cell population and function are considered in two of the normal renewal tissues, the bone marrow and the intestine. Cell proliferation following the action of radiation and chemotherapy is discussed. Studies on the rate of repopulation of tumors after radiotherapy are reviewed. It is emphasized that the rate of tumor growth is determined by three factors: the proportion of cells present that are proliferating; the rate at which these cells are dividing; and the extent of cell loss. (HLW)

24488 INFLUENCE OF RECOVERY, REPOPULATION, AND REOXYGENATION OF RADIOSENSITIVITY OF TUMORS AND NORMAL TISSUES. Fowler, J. F. (Mount Vernon Hospital, Northwood, Eng.). pp 373-388 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

The following topics are reviewed: optimum x-ray fractionation due to reoxygenation; possible differences in repair between malignant and normal tissue cells; relative magnitudes of repair and proliferation; and effects of increase of dose with time on cell proliferation rates. (HLW)

24489 CLINICAL STUDIES OF THE COMPLEXITIES OF THE RECOVERY AND ALLIED PHENOMENA. Friedman, M. (Istituto Regina Elena per lo Studio de la Cura dei Tumori, Rome). pp 389-429 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

The following topics are reviewed: paradoxes of the law of Bergonie and Tribondeau; qualitative aspects of recovery; quantitative aspects of recovery and weakness of available isoeffect recovery curves; variations in required tumor lethal dose; and variations in normal connective tissue tolerance as related to fractionation. (HLW)

24490 EFFECTIVENESS OF RADIATION IN RELATION TO GROWTH CHARACTERISTICS OF TUMORS AND NORMAL TISSUES. Breur, K. (Univ. of Amsterdam). pp 502-520 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

A clinical approach to the concept of radiosensitivity is presented, based on a number of individual observations. These observations involve tumor volume regression and radiosensitivity, growth factors, and effects of single irradiations of tumor tissue. (SFL)

24491 BIOLOGICAL-CLINICAL STUDY OF RADIOSENSITIVITY AND CHEMOSENSITIVITY OF SQUAMOUS CELL CARCINOMA OF THE MOUTH. Growth and Regression Rates, Dynamic Histology, and Cell Kinetics. Friedman, M.; Nervi, C. (Istituto Regina Elena per lo Studio de la Cura dei Tumori, Rome). pp 568-626 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

Effects of combined methotrexate and radiotherapy were studied in 22 patients with advanced squamous cell cancer of the upper air passages. Studies included clinical growth rate of tumor volume prior to treatment, cell kinetics before treatment, electron microscope studies of serial biopsies, response of tumor to methotrexate and radiation, and time and rate of recurrences. Case histories are described for four different types of tumors and results are discussed. (HLW)

Radiation Effects on Microorganisms

Refer also to abstracts 24471, 24473, and 24474.

24492 (ANL-75-30, pp 219-242) MOLECULAR GENETICS. Kubitschek, H. E. 1975.

In Division of Biological and Medical Research annual report, 1974. (Argonne National Lab., Ill. (USA)).

Progress is reported on studies on the nature and action of lethal and mutagenic lesions in DNA and the mechanisms by which these are produced in bacteria by ionizing radiation or by decay of radioisotopes incorporated in DNA. Studies of radioisotope decay provide the advantages that the original lesion is localized in the genetic material and the immediate physical and chemical changes that occur at decay are known. Specific types of DNA damage were related to characteristic decay properties of several radioisotopes. Incorporated ^{125}I, for example, induces a double-stranded break in DNA with almost every decay, but causes remarkably little damage of any other kind to the DNA. (CH)

24493 EVALUATION OF THE POST-RADIATION REPARATION CONTRIBUTION TO THE RADIOSENSITIVITY OF THE YEAST CELLS. Kapul'tsevich, Yu. G.; Petin, V. G.; Korogodina, Yu. V.; Korogodin, V. I. (Inst. Meditsinskoj Radiologii, Obninsk, USSR). Dokl. Akad. Nauk SSSR, Ser. Biol.; No. 4, 549-562(Jul 1974). (In Russian).

By comparison of the radiosensitivity of yeast cells, capable and incapable of reparation during their post-irradiation soaking in water and by determination of the viability of yeast cells of the same strain germinated at different times, the contribution of the post-radiation reparation to the radiosensitivity of the yeasts was calculated. Some traditional concepts on the quantitative regularity of the reaction of the cell to irradiation were reexamined. A method was developed for the calculation of the contribution of the effect of reparation on nutrient media to the survival of the irradiated cells and a method was also developed for the calculation of the pure survival curve characterizing the true original radiosensitivity of the cells unmodified by subsequent radiation events. It was assumed that the change with dose of the irreversible radiation injury reflects a dose dependence of the magnitude of the reparation of the irradiated cells on the nutrient media. It was shown that the survival of the cells is a mean value of the survival of cells recovering at different stages during incubation on nutrient media. (tr-auth)

Radiation Effects on Plants

Refer also to abstract 24475.

24494 (COO-3243-4, pp 117-154) BIOPHYSICS, 1975.

In annual report on research project, October 1, 1974-September 30, 1975. (Columbia Univ., New York (USA). Radiological Research Lab.).

The RBE and oxygen enhancement ratio of neutrons ranging from 0.65 to 13.4 MeV were compared with those of gamma and x radiations for the induction of somatic mutations in stamen hairs and inhibition of root growth of seedlings of Tradescantia following exposure to various doses and dose rates. (CH)

Radiation Effects on Animals

Man

Refer also to abstracts 24480, 24482, 24484, 24485, and 24488-24491.

24495 (ANL-75-30, pp 31-42) MODIFICATION OF RADIATION EFFECTS. Lindenbaum, A. 1975.

In Division of Biological and Medical Research annual report, 1974. (Argonne National Lab., Ill. (USA)).

Results are reported from studies on the tissue distribution of ^{239}Pu and ^{241}Am in mice and beagle dogs and the effectiveness of various therapeutic treatments for decorporation. In dogs injected with monomeric Pu the value of a regimen of early and prolonged treatment with DTPA (diethylenetriaminepentaacetic acid) for minimizing the Pu burden in the soft tissues and skeleton was demonstrated. These results have immediate implication for DTPA treatment in man. New studies in mice verified the action of pyran copolymer antiviral agents in enhancing the effectiveness of DTPA for removal of polymeric Pu from the liver. Recent application of autoradiographic procedures for quantitatively comparing short- and long-term localization of monomeric and polymeric ^{239}Pu in dog liver showed that there is no net translocation of monomeric Pu within the liver between 6 and 90 days following injection. One of the molecular studies presently underway aims at synthesis of a variety of DTPA esters. The diethyl ester has already been prepared and tested for toxicity in mice. These compounds are designed to bring DTPA into contact with plutonium deposits unavailable to the action of ionic DTPA. (CH)

24496 (CONF-7404104-(Abstr.)) 3RD INTERNATIONAL CONGRESS OF MAXILLOFACIAL RADIOLOGY, KYOTO, JAPAN, APRIL 18-21, 1974. Abstracts. Kriens, O. B. (ed.). (International Association of Maxillofacial Radiology). 1974. 196p.

Abstracts of the 109 papers presented at this meeting are included. Some 100 papers described diagnostic x-ray techniques for the maxillofacial region and some 10 papers discuss combined radiotherapy and chemotherapy for the treatment of neoplasms of the mouth. (CH)

24497 (COO-3428-6) STUDY OF THE LIFETIME HEALTH AND MORTALITY EXPERIENCE OF EMPLOYEES OF ERDA CONTRACTORS. Progress Report No. 11, August 1, 1974-July 31, 1975. Mancuso, T. F.; Sanders, B. S. (Pittsburgh Univ., Pa. (USA). Dept. of Occupational Health). 30 Apr 1975. Contract E(11-1)-3428. 93p. Dep. NTIS $7.75.

Preliminary data are presented from an epidemiological study of personnel of ERDA (AEC) contractors to determine any effects of radiation exposure on lifetime health and mortality. Data collected since 1964 on personnel at Hanford and Oak Ridge are presented. (CH)

24498 (INIS-mf-1716, pp 377-387) HEALTH HAZARDS FROM NUCLEAR SOURCES. Butler, G. C. [nd].

From symposium on energy resources; Ottawa, Ontario, Canada (15 Oct 1973).

In symposium on energy resources, October 15-17, 1973. (Royal Society of Canada, Ottawa, Ontario).

Debate on the health hazards associated with nuclear power centers on: (1) the quantitative relations between releases of radionuclides and dose commitments to humans; (2) the risks of late effects from a given dose of radiation; and (3) the levels of risk which are acceptable for human populations. Tables are given showing the somatic and genetic risks associated with a continual exposure of 100 mrem per year, estimates of annual whole-body dose rates in the U. S., and risk calculations for populations and selected workers. (INIS)

24499 (KURRI-TR-134) REPORT OF THE SYMPOSIUM ON THE CHROMOSOME ANOMALIES AND RADIATION: MAINLY ON HUMAN CHROMOSOME. Ikenaga, M.; Mizuma, N. (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). 19 Jan 1973. 28p. (In Japanese). Dep. NTIS (US Sales Only) $4.50.

Results of the long-term studies of late effects of atomic bomb irradiation on survivors of Hiroshima and Nagasaki undertaken at ABCC in collaboration with JNIH are briefly reviewed. Cytogenetic studies of A-bomb survivors and their children have been carried out extensively during the last several years, and the findings from the two major studies are summarized. Cells with radiation-induced chromosome aberrations were found to persist in circulating lymphocytes long after exposure to A-bomb irradiation, and the increase in frequency of such cells was closely associated with increasing exposure doses. There was no evidence so far to demonstrate genetic effects of A-bomb irradiation with respect to an increased frequency of translocation heterozygotes in offspring of A-bomb survivors. Although a slight increase of individuals with sex chromosome aneuploidy was observed, at present it neither is statistically significant, nor is there any experimental evidence for an elevated prevalence of sex-chromosome non-disjunction induced in parental germ cells by irradiation. (auth)

24500 (LA-UR-75-1633) MESON RADIOBIOLOGY AND THERAPY. Kilgerman, M. M. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1975. Contract W-7405-ENG-36. 8p. (CONF-750824-5). Dep. NTIS $4.00.

From 7th international conference on cyclotrons and their applications; Zurich, Switzerland (19 Aug 1975).

High-linear energy transfer radiation (neutrons, heavy ions, and pions) have a greater relative biological effectiveness than low-linear energy transfer radiation by depositing a high density of ionization in irradiated cells. This overcomes the protective effect of oxygen; decreases the variation in sensitivity among the several stages of the cell cycles; and, inhibits the repair of sublethal damage as compared to x-rays, gamma rays, electrons and protons. Negative pi mesons (pions), appear particularly suited for radiation therapy as their penetration and depth-dose profile lend themselves to shaping the high dose area to the tumor size and location. Preliminary biological experiments with pions produced at the Los Alamos Meson Physics Facility studied cell survival at various radiation depths and cell cycle sensitivity. Histologic study of data from the first human experiments indicated severe tumor cell destruction by pions as compared to x-rays in treating malignant melanoma skin nodules, without increased effects on dermal elements. (auth)

24501 CLINICAL COMMENTARY ON RADIATION TREATMENT AT A LOW DOSAGE RATE. Sahatciev, A.; Pandova, V.; Delcev, S. Probl. Onkol.; 1: 109-114(1973). (In Russian).

A study was made on the effect of low dosage rate in telegammatherapy of four patients with advanced otorhinolaryngological tumors. The total dose of 6000 rd was administered in six consecutive days. The daily dose of 1000 rd was given by continuous irradiation at a low dosage rate–2.5 rd/min (during 6.66 hours) or in 16 fractions at 62.5 rd each at intervals of half an hour. Regression of the primary tumor and the metastatic lymph nodes occurs shortly. Severe radiation reactions of the mucosae are observed, the early skin effects being marked as well. Remote changes of the healthy tissue occur in the sixth month following irradiation and are manifested with atrophy of the mucosa and fibrosis of the soft tissues. Local recurrences were detected after the sixth month as well. (Abstr. Bulg. Sci. Med. Lit.)

24502 ^{252}Cf FOR TREATMENT OF MALIGNANT TUMORS OF THE SKIN. Kozlova, A. V.; Zamyatin, O. A.; Mirzoev, E. A. Med. Radiol.; 20: No. 7, 78-82(Jul 1975). (In Russian).

The authors determined relative biological efficacy (RBE) of mixed radiation of ^{252}Cf as being 6 to 7 in experiments made on mice. In administering neutron therapy in the clinic RBE was not higher than 5. The article presents the methods of treatment of patients with cancer and melanoma of the skin, describes the character of radiation reactions, regression of tumors depending upon the doses of neutron radiation, histological structure of the tumors, and the immediate results of treatment. It is necessary to continue the tests of ^{252}Cf for its evaluation in the clinic. (auth)

24503 ^{252}Cf FOR THERAPY OF TUMORS. Zherbin, E. A.; Vtyurin, B. M.; Lychev, V. A.; Sul'kin, A. G.; Senyukov, M. V.; Nazarov, G. I.; Nikitenko, V. A.; Elisyutin, G. P.; Medvedev, V. S.; Matyakin, G. G.; Savina, N. P.; Lebedtsov, A. A. (Scientific-Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 20: No. 7, 73-77(Jul 1975). (In Russian).

The authors generalized the first experience in therapy with ^{252}Cf of nine patients with recurrent tumors. The methods of treatment, calculation of absorbed doses, immediate and the nearest results of treatment are described. The authors go on with the study of the efficacy of neutron therapy in the clinic. (auth)

24504 RADIATION LOAD FROM SECONDARY AND SCATTERED PARTICLES IN IRRADIATION WITH PROTONS. Lomanov, M. F.; Minakova, E. I.; Vainson, A. A.; Blokhin, S. I.; Podsvirova, V. I.; Khoroshkov, V. S.; Shimchuk, G. G.; Shmakova, N. L. (Inst. of Theoretical and Experimental Physics, Moscow). Med. Radiol.; 20: No. 7, 40-48(Jul 1975). (In Russian).

The authors made measurements on a biomedical proton beam of the ITEP synchrotron of the dose from secondary and scattered protons and neutrons in the phantom experiments which modelled many-field and convergent irradiation of the hypophysis with pencil (6 to 7 mm in diameter) beam of protons with an energy of 200 MeV and a single-moment massive irradiation of radioresistant tumours of different localization with a broad beam (up to 100 mm in diameter) of protons with energies of 100 and 155 MeV. For physical measurements of the equivalent dose use is made of hardbody track detectors which register the fission fragments of ^{238}U, and nuclear photoemulsions. Biological dosimetry was made according to the survival of the cells of the Chinese hamster and induction of chromosome abberations in the bone marrow of mice. Comparison of the results of physical and biological dosimetry gave satisfactory results. In convergent irradiation of the hypophysis from 25 fields through the dose in the studied critical regions (formation in the region of posterial cranial fossa and orbit) on the average amounts to 15 rem and does not exceed 80 rem with a single-time dose in the centre of convergence (dosage centre) of 15000 rad. In cases of single-moment irradiation with broad beams in a dose of 15000 rad (at most), the dose of secondary mixed irradiation does not exceed 150 rem at a distance of 3 to 4 cm from the edge of the geometrical field of irradiation (50 per cent of isodose) and 25 bar at a distance of 15 cm from the field edge. (auth)

24505 HISTOLOGICAL FEATURES IN THE LOCAL RADIOCURABILITY OF CARCINOMAS. Glucksmann, A. (Inst. of Animal Physiology, Cambridge, Eng.). pp 203-218 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

Qualitative differences in radiocurable tumors are emphasized. Keratogenesis as a prominent feature of radiocurable squamous cell carcinomas is discussed. The rapid increase in keratogenesis and the rapid loss of viable cells by keratinization are discussed as the main features in distinguishing a good from a poor response to irradiation. Vascular and inflammatory effects of radiation are described and the reduction in width and structural disruption of epithelium following irradiation are discussed. (HLW)

24506 RECOVERY, REOXYGENATION AND A STRATEGY TO IMPROVE RADIOTHERAPY. Elkind, M. M. (Hammersmith Hospital, London). pp 343-372 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

Studies on basic principles, fractionation with and without reoxygenation, and isosurvival theory are reviewed. Studies on physiological sensitization are reviewed under the following headings: mammalian cells in culture; tumors and tumor cells; and reoxygenation vs. sublethal damage repair. The use of physiological sensitization to improve fractionation radiotherapy is considered. (HLW)

24507 RANGE OF PRESCRIBED TUMOR LETHAL DOSES (PTLD) IN THE TREATMENT OF DIFFERENT HUMAN TUMORS. Rubin, P.; Keller, B.; Quick, R. (Univ. of Rochester, NY). pp 435-484 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

The prescribed lethal tumor dose is defined as the perfect balance to achieve maximal tumor control probability and minimal normal tissue injury. The therapeutic dose utilized in selected situations is the dose required by the radiation therapist for the most effective treatment in his clinical judgment. A tabulation of

such doses from a number of major centers indicates the range of doses employed for specific cancers. These have been analyzed as time-dose plots. A number of models for the choice or selection of the required dose have been presented. Strandqvist lines, single dose references or equivalent dose normograms are examined. The value system of the radiotherapist in assessing negative outcomes and in Bayesian model matrices of probability and desirability or in ROC curves needs further exploration. New strategies in treating primary tumors, occult lymph node involvement and occult hematogenous metastases have been offered, based on clinical and radiobiological observations. (auth)

24508 CLINICAL DOSE-RESPONSE CURVE OF SUBCLINICAL AGGREGATES OF EPITHELIAL CELLS AND ITS PRACTICAL APPLICATION IN THE MANAGEMENT OF HUMAN CANCERS. Fletcher, G. H. (Univ. of Texas, Houston). pp 485-501 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

Practical applications of the dose-response curve of subclinical aggregates of epithelial cells are reviewed with regard to adenocarcinoma of the breast, squamous cell carcinoma of the upper respiratory and digestive tract, and nonseminomatous tumors of the testes. Other topics discussed are irradiation of clinically negative node areas in conjunction with irradiation of the primary lesion, preoperative irradiation, postoperative radiotherapy, and combination of conservative surgery with irradiation. (HLW)

24509 CHEMOTHERAPY ENHANCEMENT OF RADIOSENSITIVITY AND CLINICAL RADIOCURABILITY. Kligerman, M. M. (Univ. of New Mexico, Albuquerque). pp 528-534 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

Evidence for chemical sensitization of radiation in clinical radiotherapy is reviewed. Some topics discussed are: incorporation of IUDR and BUDR into DNA; and metabolic inhibition of DNA synthesis using 5-fluorouracil, methotrexate, hydroxyurea, and actinomycin D. It was concluded that clinical exploitation of known radiation sensitizers is still to be accomplished and that drugs that are not sensitizers but that are in themselves tumoricidal may still be found useful. (HLW)

24510 CHEMOTHERAPY DISRUPTION OF EFFICIENT RADIOTHERAPY. Nervi, C.; Friedman, M. (Istituto Regina Elena per lo Studio e la Cura dei Tumori, Rome). pp 535-547 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

Studies on the use of chemotherapy in combination with radiotherapy are reviewed. Some topics discussed are: indications for the use of combined chemotherapy and radiotherapy; improvement of the therapeutic ratio following the use of methotrexate; advantages of preirradiation and postirradiation chemotherapy; side effects following simultaneous chemotherapy and radiotherapy; and effects of chemotherapy on cure rate of radiosensitive and radioresistant tumors. (HLW)

24511 IS OXYGEN IMPORTANT IN THE RADIOCURABILITY OF HUMAN TUMORS. Withers, H. R.; Suit, H. D. (Univ. of Texas, Houston). pp 548-560 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

It is quite likely that untreated human tumors contain hypoxic cells. Frequently, perhaps usually, the presence of these hypoxic cells does not influence radiocurability. If hypoxia limits radiocurability, it is more likely to do so in the treatment of large tumors and maybe with greater likelihood in tumors in certain sites. Hypoxia would also be more likely to affect response to a small number of fractions, since reoxygenation would need to be more complete in order that cell killing by the larger dose fractions used would not be prejudiced by the hypoxia of a small proportion of cells. Hyperbaric oxygen is disappointing as an adjuvant to radiotherapy. Results obtained are not better than those obtained using the best conventional fractionation regimes in air. This does not prove, however, that hypoxia is not a cause of failure to control tumors locally, since physiological adaptive mechanisms against HPO such as vasoconstriction may prevent better oxygenation of the tumor. If other methods such as high LET beams are to be used to reduce any effect hypoxia may have on radiocurability, their greatest benefit would be expected in the local control of late-stage disease and this benefit may be greater in some tumor sites than others. (auth)

24512 ENVIRONMENTAL DOSE COMMITMENT. Richardson, A. C. B. (Environmental Protection Agency, Washington, DC). Health Phys.; 29: No. 2, 353-354(Aug 1975).

Reference is made to a communication from Dr. Bo Lindell in the Journal of the Health Physics Society concerning the report of the U. S. Environmental Protection Agency on environmental dose commitment. Comment is made on the use of the phrase "maximum potential individual dose" in the report, the calculation of the EPA environmental dose commitment as an extension of the general formulation in the 1969 UNSCEAR report which takes account of the time dependence of population size and computes directly the population (or collective) dose rather than the average dose, the applications of dose commitments to calculation of total impact of the nuclear power industry, and tentative adoption of 1 man-rem/MW(e)-yr limit in Sweden for the total nuclear fuel cycle. (UK)

Vertebrates

Refer also to abstract 24475.

24513 (ANL-75-30, pp 7-29) RADIATION TOXICITY IN DOGS. Norris, W. P. 1975.

In Division of Biological and Medical Research annual report, 1974. (Argonne National Lab., Ill. (USA)).

Progress is reported on studies of the effects of continuous (22 hr/day), whole-body gamma-irradiation in the pure-bred beagle dog. Dogs were exposed continuously until death at one of four different exposure rates ranging from 5 to 35 R/day. The study is still 2441 days (approximately 6.7 yr) of irradiation. The experiment has narrowed to the dogs receiving 5 R/day and the controls. A group of dogs receiving one of these relatively low daily exposure rates may exhibit remarkably varied responses, both in survival times in the gamma field and in ultimate causes of death. The basis for these large differences in responses of individual dogs remains mostly unexplained, but is presumed to reside in their genetic composition. The composite result in the study, however, demonstrates an orderly, step-wise appearance of clinical end points resulting from radiation-induced damage to the blood-forming tissues. About one-half the dogs exposed continuously to 10 R/day develop bone marrow aplasia and die of anemia, while the other one-half develop bone marrow hyperplasias and die of malignancies, usually myelogenous leukemias. In dogs exposed at rates greater than 10 R/day, aplastic bone marrows predominate; while hyperplastic responses are the dominant cause of death at 5 R/day. Only among the most recent deaths of dogs exposed continuously to either 10 or 5 R/day, have there appeared terminal causes of death unrelated to hematopoietic injury. These causes (degenerative and/or inflammatory disease and cancers of tissue other than bone marrow) suggest that we are now beginning to define the combinations of exposure rate and time of exposure that allow expressions of damage by tissues outside the hematopoietic system. (auth)

24514 (ANL-75-30, pp 43-74) NEUTRON AND GAMMA-RAY TOXICITY STUDIES. Ainsworth, E. J. 1975.

In Division of Biological and Medical Research annual report, 1974. (Argonne National Lab., Ill. (USA)).

Results are reported from studies on the late effects of irradiation on large populations of mice. The effectiveness of neutron and gamma radiation for production of neoplastic and non-neoplastic diseases and life shortening are compared. Basic studies of cellular and functional indices of radiation injury, which provide the opportunity for fundamental new contributions to the understanding of late radiation effects in the vascular, immune, and hematopoietic systems are also reported. Both structural and functional changes in the vasculature have been observed during the second year after irradiation. The structural changes in the pinna include collapse of arteries, arterioles, and some veins along with alterations in the smooth musculature and accumulation of significant fibrosis. Late ultrastructural changes observed in myofibrils involve the endoplasmic reticulum and mitochondria. Cardiac muscle showed alteration in the size and number of mitochondria and fibrosis development within 7 days of irradiation. (CH)

24515 (COO-2366-4) DAMAGE AND REPAIR IN SKIN FOLLOWING EXPOSURE TO RADIOACTIVE PARTICLES, Progress Report for the Support Period Ending 31July 1975. Forbes, P. D. (Temple Univ., Philadelphia, Pa. (USA). Skin and Cancer Hospital). 1975. Contract AT(11-1)-2366. 8p. Dep. NTIS $4.00.

Preliminary results are reported from studies on the carcinogenic effects of radioactive particles on the skin of mice and miniature swine. Silicate-^{90}Sr microspheres of various sizes were applied to the skin at various sites for various periods of time and the animals were observed for erythema and skin

tumors in response to the radiation dose received. Skin tumors were observed in mice after 10 weeks of exposure. (CH)

24516 (SAN-410-181) BASIC STUDIES OF THE IMMUNE RESPONSE AND THE EFFECTS OF RADIATION ON THIS RESPONSE. Dixon, F. J. (Scripps Clinic and Research Foundation, La Jolla, Calif. (USA)). 30 Jun 1975. Contract AT(04-3)-410. 9p. Dep. NTIS $4.00.

The cellular events involved in the reconstitution of the immune response in lethally irradiated mice were studied. Special attention was given to suppressor T cells and their possible involvement in the induction and maintenance of immunological unresponsiveness. The suppressor activity of such cells was studied both in vivo and in vitro. Experiments were carried out to determine if affinity labeled cells (labeled with a hapten) can reconstitute irradiated recipient mice without further addition of antigen and to determine what effect prior in vitro irradiation of these cells had on their in vivo response. Studies on the role of lipopolysaccharide (LPS) in the interference with tolerance induction and the relationship of the adjuvant and mitogenic properties of LPS were extended. Preliminary studies were carried out to determine the effect of in vitro irradiation on activated thymus-derived (T) cells of the spleens of mice. The mechanisms by which whole-body irradiation increases the susceptibility of adult mice to infection by murine leukemia virus were also studied. (auth)

24517 COMPARATIVE MORPHOLOGICAL AND HISTOLOGICAL STUDY OF THE THYMUS AND BURSA FABRICII OF YOUNG CHICKS (GALLUS GALLUS L.) OF THE WYANDOTTE STRAIN FOLLOWING IRRADIATION. Giancarlo, G.; Pelosi, A.; Catalini, N. (Univ., Rome). Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Nat.; 55: No. 5, 592-599(Nov 1973). (In Italian).

A morphological and histological study of the thymus and of the bursa Fabricii of young chicks (Gallus gallus, Wyandotte strain) following to x-ray treatment (600 R) was undertaken for comparative purposes. The two irradiated lymphoid organs displayed different histological patterns. Picnotic lymphocytes were found in the most peripheral cortical region of the thymus (where small lymphocytes represent the majority of the cells) only during the first 3 days after irradiation. In the bursa, instead, the picnotic lymphocytes could be observed until the end of the experiment (30 days), both in the cortical and in the medullar region. (auth)

24518 COMPARISON OF MORPHOLOGICAL CHANGES IN THE BRAIN CELLS OF IRRADIATED GUINEA PIGS WITH THOSE IN BLOOD-FORMING TISSUES AND GONADS. Bregadze, M. A.; Lagidze, T. P. (Inst. of Physiology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 79: No. 1, 189-192(Jul 1975). (In Russian).

The paper considers experimental findings on the primary and secondary patterns of structural affection of the brain cells, blood-forming tissues, and gonads in guinea pigs following a local exposure (of the head, while screening the body and vice versa) to x rays. (auth)

24519 INFLUENCE OF REPEATED AND FRACTIONARY IRRADIATION ON THE FREQUENCY OF CHROMOSOME REARRANGEMENTS IN GERM CELLS OF MALE MICE. Gugushvili, B. S.; Fazylov, U. T. (Scientific-Research Inst. of Medical Radiology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 79: No. 1, 213-216(Jul 1975). (In Russian).

The radiosensitivity of premeiotic germ cells was studied. The percentage of chromosome rearrangements under various conditions of irradiation served as an index. Irradiation of spermatogonial cells with 50 to 400 R resulted in a rise of the frequency of multivalent configurations as the dose increased. Only repeated irradiation led to a weakening of the mutagenic effect. (auth)

24520 LOCAL LESIONS AFTER BRAIN IRRADIATION WITH A NARROW BEAM OF PROTONS. Minakova, E. I.; Vinogradov, V. N. (Inst. of Experimental and Clinical Oncology, Moscow). Med. Radiol.; 20: No. 7, 33-39(Jul 1975). (In Russian).

The authors give the results of model experiments made on animals aimed at studying the effect of a narrow beam of protons with an energy of 200 MeV made up on a synchrotrone of the Institute for Theoretical and Experimental Physics on various intracranial structure; the synchrotrone is intended for clinical use. Irradiation with narrow beams of different diameter (3 and 5 mm) in the range of doses of 30,000 to 2000 rad showed that the made up beam and elaborated equipment make it possible to reach destruction of the preset volume of the tissue, with distinct borders determined by a high gradient on the border of the formed dose fields. The data obtained as a result of experiments are original information for the choice of conditions and parameters of multifields convergent through irradiation with a narrow beam of protons in the hypophysis in man. (auth)

24521 IRRADIATION OF HYPOPHYSIS WITH PROTONS AT AN ENERGY OF 1000 MeV. Konnov, B. A.; Ulitovskii, D. A. (Central Scientific-Research Rentgeno-Radiological Inst., Leningrad). Med. Radiol.; 20: No. 7, 48-52(Jul 1975). (In Russian).

With the aim of processing the results of radiation hypophysectomy, a total of 32 dogs were irradiated by the protons with the use of a pendulum stereotaxic method on the synchrocyclotron of the Leningrad Institute of Nuclear Physics which was focused on the hypophysis. The morphological investigations of the hypophysis preparations were conducted with the use of the methods of Nissl, Van Gizon, Vaigert, Gros-Bilshovsky, staining by hematoxylin-eosin. Conclusions have been drawn concerning the biological influence of the protons in the range of the doses on the tissues of the head, the narrowness of the radionecrosis zone, intactness of the surrounding tissues, possible complications and their causes; an opinion has been voiced of the optimal dose. (auth)

24522 BIOLOGICHESKOYE DEYSTVIYE NEYTRONOV I KHIMICHESKAYA ZASHCHITA. (Biological Actions of Neutrons and Chemical Protection). Sverdlov, A. G. Leningrad; Izdatel'stvo Nauka (1974). 223p.

The possibilities for the use of different neutron sources for biological experiments are examined and the feasibility of using the vertical channels of reactors for these purposes is discussed. The characteristics of the spatial-energy distribution of neutrons in different biological objects are described. An evaluation is given of the relative biological effectiveness (RBE) of neutrons and the factors determining it during the irradiation of cells and animals of different shape. The singularities of the reactions of mammals to the effects of neutrons and the different value of the injuries to the critical systems during irradiation of different types of animals by neutrons and x-rays or γ rays are characterized. The possibilities of modifying the effects of neutron irradiation (change of the dose rate, dose fractionation, oxygen effect) are evaluated. The characteristics of the post-radiation recovery from neutron irradiation are given. The effectiveness of hypoxy reagent, sulfur-containing compounds, indolylalkylamines, their combinations, D O, DNA, polysaccharides, and other compounds for the protection of mice during multiple neutron irradiations was investigated. The combination of chemicals and conditions promoting the repopulation of hematopoietic tissue is also evaluated. (444 references) (tr-auth)

24523 RADIATION EFFECTS ON BIOMEMBRANES. Wallach, D. F. H. (Tufts-New England Medical Center, Boston). Biomembranes; 5: 213-249(1974).

The following topics are reviewed: the genesis of radiation effects; weak links; radiation chemistry of membrane-associated substances; effects of ionizing radiation on membrane morphology; radiation effects on membrane function; membrane SH groups; the role of nuclear membranes in radiation damage; and pleiotropic effects. (HLW)

24524 EFFECTS OF LOW LEVELS OF RADIATION ON RODENTS AND POTENTIAL EFFECTS IN MAN. Warren, S. (New England Deaconess Hospital, Boston). Health Phys.; 29: No. 2, 251-255(Aug 1975).

From Health Physics Society annual meeting, workshop on cancer producing effects of low-level ionizing radiation; Houston, Texas (10 Jul 1974).

The potential variability of population groups both human and rodent is emphasized. Examples are given of human populations especially susceptible to the development of cancer, some where the underlying mechanisms are understood, some where they are as yet unknown. A number of examples of variation in susceptibility to leukemia, mammary cancer, and other tumors in different experimental rodent populations are presented. There is evidence that intrinsic factors inherent in any given group must be considered as well as the extrinsic factors. Fortunately, the factors of safety in the calculation of permissible dose levels appear to have been adequate to protect those members of exposed population groups having special susceptibilities. (auth)

Invertebrates

24525 (SAND-75-0163) INACTIVATION OF ASCARIS LUMBRICOIDES EGGS BY HEAT, RADIATION, AND THERMORADIATION. Brannen, J. P.; Garst, D. M.; Langley, S. Sandia Labs., Albuquerque, N. Mex. (USA); Sandia Labs., Livermore, Calif. (USA)). Jul 1975. Contract AT(29-1)-789. 22p. Dep. NTIS $4.25.

It is desirable to eliminate the public health hazards associated with land application of municipal sewage sludge as a fertilizer or soil conditioner. This report describes experimentation to determine the effects of heat, radiation, and thermoradiation on the suppression of embryonation of Ascaris lumbricoides ova, a parasite commonly found in sewage sludge. Heat effects were observed at a minimum temperature of 51°C and radiation effects

at doses in excess of 15 krads of radiation. Thermoradiation at 47°C suppressed embryonation at less than half the total dose required by radiation alone. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 24497, 24723–24725, and 24737.

Animals

24526 LONG-TERM EFFECTS OF INTRATRACHEALLY INSTILLED $^{253}EsCl_3$ IN RATS. Ballou, J. E.; Dagle, G. E.; Morrow, W. G. (Battelle Pacific Northwest Labs., Richland, WA). Health Phys.; 29: No. 2, 267-272(Aug 1975).

Male Wistar rats were administered $^{253}EsCl_3$ by intratracheal instillation and the biological effects were followed for the animals lifespan or 880 days. Three dose levels were employed; 47.2, 10.7, and 0.214 μCi/kg along with controls given pH 2 HCl by instillation. The estimated radiation dose to lung was 9800, 1900, and 38 rads, respectively. The dose to bone was about $\frac{1}{5}$ the lung dose. The earliest biological effects were dose related, e.g., impaired weight gain and death due to radiation pneumonitis. The late effects included bone and/or lung tumors in all experimental groups. The tumor site and incidence are discussed and related to similar data for plutonium compounds. (auth)

Nuclide Kinetics and Toxicology

Man

24527 EXAMPLES OF INTERNAL CONTAMINATION BY TRITIUM-THYMIDINE HAVING SHORT HALF-LIVES. Nishizawa, K. (Nagoya Univ., Japan); Takeuchi, A.; Hotta, T. Health Phys.; 29: No. 2, 348-349(Aug 1975).

The results of monitoring for tritium in urine of people who worked in tritium-thymidine decontamination facilities are given. Slight contamination was observed in two of six cases. The biological half-lives were measured, in order to deduce the initial intake activity of tritium and the internal absorbed dose. The measured biological half-lives were 1.3 ± 0.4 and 2.4 ± 0.6 days, shorter than previously reported values. (UK)

Animals

Refer also to abstracts 24338 and 24347.

24528 (BNWL-SA-5294) TOXICITY OF INHALED Ca-DTPA IN THE BEAGLE DOG. Smith, V. H.; Ragan, H. A.; Lund, J. E.; Hackett, P. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract AT(45-1)-1830. 5p. (CONF-750707-3). Dep. NTIS $4.00.

From annual meeting of the Health Physics Society; Buffalo, New York, USA (13 Jul 1975).

There are several advantages to the administration of Ca-DTPA by inhalation rather than intravenous drip for the decorporation of certain radionuclides. Among these are the possibility of treating very promptly following an accidental incorporation to achieve maximum treatment effectiveness and convenience for medical management, even to the extent that treatment can be self-administered. The present investigational New Drug permit allows treatment of humans only by the intravenous route and animal studies are required to justify the new route. Earlier work in rats and hamsters showed five successive daily inhalations of Ca-DTPA aerosols (dose 1 to 4 times human i.v. dose) produced a transitory emphysema in 17/40 rats serially sacrificed up to 3 weeks following the last exposure and in 10/20 hamsters up to 1 week after exposure. No emphysema was seen in rats sacrificed after 3 weeks and in hamsters after 1 week following the exposures. Results of tests in dogs administered DTPA by inhalation showed hyperplasia of the gastric submucosal lymphoid follicles observed 1 week following the last exposure may be treatment-related, but other observed changes were considered unrelated. (CH)

24529 CONCENTRATION OF ^{54}Mn, ^{55}Fe, ^{57}Co, AND ^{45}Ca BY IDOTHEA METALLICA IN DEPENDENCE ON WEIGHT. Kulebakina, L. G. pp 40-43 of Radiokhemo-Ekologicheskie Issledovaniya v Sredizemnom More. Kovalevskii, A. Kiev; Naukova Dumka (1975). (In Russian)

Concentration of ^{54}Mn, ^{55}Fe, ^{57}Co, and ^{45}Ca by Idothea metallica is an exponential function of the body weight and length. (auth)

24530 RESERPINE-INDUCED CHANGES IN THE UPTAKE AND DISTRIBUTION OF RADIOLABELLED CALCIUM AND MAGNESIUM IN THE BRAIN PITUITARY GLAND OF THE RAT. Sabot, I.; Rovner, E.; Costin, A. (Univ. of California, Los Angeles). Experientia; 31: No. 7, 835-836(15 Jul 1975).

Rats were administered reserpine for 3 days prior to the intracarotid administration of either ^{45}Ca or ^{28}Mg and the effects of the reserpine administration on the uptake and distribution of the ^{45}Ca and ^{28}Mg in the brain and pituitary gland was determined. It was found that the chronic administration of reserpine prior to injection of the radioisotopes significantly increased the uptake of ^{45}Ca, but not ^{28}Mg, in the brain and pituitary gland of the rats. (ERB)

24531 SEPARATION OF ^{241}Am FROM ^{239}Pu DURING TRANSITION FROM SOLUTION TO BONE TISSUE. Basalaeva, L. N.; Ivanova, N. P.; Nazarov, V. V.; Popov, D. K. (Leningrad Scientific-Research Inst. of Radiation Hygiene). Med. Radiol.; 20: No. 7, 86-90(Jul 1975). (In Russian).

The article presents the results of observations of ^{241}Am and ^{239}Pu distribution along the different bones of mice after a single intraperitoneal introduction of ^{239}Pu citrate(IV). Unevenness of the distribution of these isotopes in the bones of the skeleton was observed. Separation of Pu from Am was noted in the link bone tissue — solution. This makes it impossible to determine intravital quantity of ^{239}Pu in the skeleton on γ irradiation of ^{241}Am without making a corresponding correction. (auth)

24532 INFLUENCE OF AGE AND SEX ON THE ACTIVITY RATIO OF YTTRIUM-90 TO STRONTIUM-90 IN THE RAT SKELETON AFTER INCORPORATION OF STRONTIUM-90. Stevenson, A. F. G. (Heiligenberg-Institut, Ger.). Health Phys.; 29: No. 2, 285-290(Aug 1975).

The influence of age and sex on the behavior and distribution of ^{90}Sr and ^{90}Y was investigated in albino rats after administration of solutions with ^{90}Sr-^{90}Y in radioactive equilibrium. The ratio of Y/Sr, Q, was found to be proportional to age and was also significantly higher for female animals as compared to males. Sex and age acted additively, increasing the radioactive burden of the bones in the case of female animals substantially. (auth)

24533 PLUTONIUM AND OTHER ACTINIDE ELEMENTS IN GONADAL TISSUE OF MAN AND ANIMALS. Richmond, C. R.; Thomas, R. L. (Los Alamos Scientific Lab., NM). Health Phys.; 29: No. 2, 241-250(Aug 1975).

The report summarizes available information on the gonadal content of mammalian species given various actinide elements by various routes of administration. Emphasis is placed on plutonium. Also discussed is the contemporary level of plutonium from nuclear weapons fallout in human subjects. The fraction of the administered burden of plutonium found in the gonads (FABG) of five mammalian species following intravenous injection was about 3×10^{-4} with only about a factor of 10 between the highest and lowest values to allow for differences between sexes, among species, or as a function of time following injection. FABG values tend to be smaller in the female, as compared with the male, and following inhalation or subcutaneous implant. Data on the FABG for other actinides are qualitatively similar to those for plutonium. The gonadal plutonium concentrations from fallout in US residents are about 0.5 pCi/kg, not unlike those reported for other soft tissues, except thoracic lymph nodes, and bone. (UK)

24534 INHALATION EXPOSURES OF BEAGLE DOGS TO CERIUM AEROSOLS. Physical, Chemical, and Mathematical Analysis. Cuddihy, R. G.; Gomez, S. R.; Pfleger, R. C. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). Health Phys.; 29: No. 2, 257-265(Aug 1975).

A biomathematical model for describing tissue distribution and whole-body retention of inhaled ^{144}Ce was developed from studies with beagle dogs. Lung clearance of ^{144}Ce after inhalation exposure to $^{144}CeCl_3$ in CsCl or $CeCl_3$ aerosol particles was measured and compared with elution rates for ^{144}Ce from aerosol samples in an in vitro, static solvent dissolution system. Various solvents including NaCl or sodium citrate in Tris buffered solutions at pH 6.5, 7.0, or 7.5 and simulated serum solutions were used. Increased elution rates were obtained by including sodium citrate, a chelating agent, and by decreasing pH. Elution rates for ^{144}Ce from aerosol samples in sodium citrate at pH 7.0 and 7.5 were the most similar to estimated absorption rates for ^{144}Ce from lungs of dogs after inhalation exposure. In contrast to previous studies in which barium was eluted from various aerosols in simulated serum solutions at similar rates to lung clearance in dogs, no elution of ^{144}Ce from filter samples was observed in this study. Lung clearance and in vitro elution of ^{144}Ce were more rapid from CsCl aerosol particles than from $CeCl_3$ particles. Further dissolution studies with ^{144}Ce oxide and ^{144}Ce entrapped in fused clay aerosols yielded predicted lung clearance half-times of several hundred days. (auth)

24535 FLUORINE-18 METABOLISM IN THE ACUTELY UREMIC RAT. Frascino, J. A.; Freed, B. R.; Woodard, H. Q.

(Memorial Hospital, New York). Health Phys.; 29: No. 2, 279-283(Aug 1975).

Fluorine-18 as carrier-free NaF was injected intracardially into young adult male rats, either normal (C) or made acutely uremic (U) by previous intramuscular injection of glycerol. At times up to 5 hr later the rats were killed and the ^{18}F in aortic blood, muscle, liver, kidneys, testes, urine and ends and shafts of tibias was measured. Clearance of ^{18}F from blood was slower in U than in C. In both groups ^{18}F in muscle and liver followed blood kinetics. There was evidence of active storage in the testes. The usual high uptake in bone was seen in C. In U the bones fixed only 0.3 to 0.4 as much of the ^{18}F of blood as did the bones of normals, but, since the concentration of ^{18}F in blood was 2 to 3 times as high in U as in C, the net bone uptake was nearly the same. In C the ^{18}F concentration in the kidney was always at least twice that in blood, but followed similar kinetics. In U the concentration of ^{18}F in the kidney rose to 10 to 20 times that in blood, with resultant increase in radiation dose to the kidney. (auth)

24536 CESIUM KINETICS DATA FOR ESTIMATING FOOD CONSUMPTION RATES OF TROUT. Hakonson, T. E.; Gallegos, A. F.; Whicker, F. W. (Colorado State Univ., Fort Collins). Health Phys.; 29: No. 2, 301-306(Aug 1975).

The data from a cesium kinetics experiment in a natural semi-drainage bog lake were used in estimating the rate of food consumption and the rate of cesium excretion by rainbow trout (Salmo gairdneri) which inhabit the lake. Estimates of the ^{137}Cs retention half-time and food intake were shown to vary greatly throughout the year. For example, based on observed data and theoretical considerations, trout consumed only about 0.5 percent of their body weight daily in mid-winter but up to 8 percent in early summer. In addition, cesium retention half-times ranged from about 100 days in summer to 850 days in mid-winter, based upon water temperature, body weight, and growth. (auth)

24537 EFFECT OF THE ADDITION OF DIFFERENT DOSES OF VITAMIN E ON THE METABOLISM OF ^{75}Se IN THE ORGANISM OF GROWING CHICKENS. Stanchev, Kh. Dokl. S-kh. Akad., Sofia; 6: No. 3, 267-270(1973).

Plants

Refer also to abstracts 24348 and 24349.

24538 (UCB-34P211-2) UPTAKE OF PLUTONIUM AND AMERICIUM BY PLANTS FROM SOILS. Schulz, R. K.; Tompkins, G. A.; Babcock, K. L. (California Univ., Berkeley (USA). Dept. of Soils and Plant Nutrition). 16 Jun 1875. Contract AT(04-3)-34. 38p. Dep. NTIS $5.00.

Plant uptake of $^{239,240}Pu$ and ^{241}Am was studied on two soil samples collected on the Nevada Test Site. These soils had each been previously contaminated with the radionuclides by high explosive detonation of devices containing plutonium. The $^{239}PuO_2$ equivalent diameters of plutonium bearing particles present in the soil samples were determined and found to be log-normal in the range of 0.2 to 0.7 mu m. Particles were examined by electronmicroscopy and found to be 2 to 3 times larger than the $^{239}PuO_2$ equivalent diameter. Electron microprobe analysis showed that these particles consisted primarily of Pu, U, and O, with Al, Si, Fe and Mg present in much smaller amounts. The plutonium distribution ratio (D. R. equals nuclide concentration in plant/nuclide concentration in soil) was in the order of 10^{-5} for barley plant vegetation and was 20 to 100 times lower for barley grain. The D. R. for ^{241}Am was in the order of 10^{-4} for vegetative growth and 25-75 times lower for the grain. In other uptake experiments three different soils were utilized: slightly acid forest soil, neutral valley soil, and calcareous alkaline soil. The $^{239,240}Pu$ and ^{241}Am were added to the soil as nitrate or chloride solution to facilitate the addition of Pu to soil in different oxidation states. Where Pu in the higher oxidation states (nitrate) was added to the alkaline calcareous soil the highest plant uptake was observed. In uptake experiments with wheat the plutonium distribution ratio of the grain ranged from about 4×10^{-6} to 4×10^{-5}. The ^{241}Am D. R.'s ranged from 3×10^{-7} to 3×10^{-5}. (auth)

New Tracer Techniques

Refer also to abstract 24193.

24539 BIOLOGICAL CHARACTERISTICS AND DIAGNOSTIC APPLICATION OF LABELED PHYTIC ACID. Kocsar, L. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszsegugyi Kutato Intezet, Budapest); Spett, B.; Kutas, V.; Mann, Somosi, Z. Izotoptechnika.; 18: No. 5, 205-207(May 1975). (In Hungarian).

Technetium-99m-labeled phytic acid, after intravenous injection, has a biological half-life of 1 to 2 hrs. Tests showed that it is nontoxic to the patient and is well suited for reticulo-endothelium diagnosis. (JSR)

24540 QUANTITATIVE AND QUALITATIVE INVESTIGATION OF NATURAL MICROFLORA OF DRY CAT-GUT TO BE STERILIZED BY IRRADIATION. Gazso, L.; Igali, S. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszsegugyi Kutato Intezet, Budapest). Izotoptechnika.; 18: No. 5, 236-241 (May 1975). (In Hungarian).

Based on the determination of initial microbial contamination of cat-gut a sterilizing dose of 3,5 Mrad was found to be appropriate. (auth)

24541 KINETICS OF CELL PROLIFERATION IN NORMAL TISSUE, MALIGNANT TUMORS, TUMORS OF THE UPPER AIR PASSAGES. Fabrikant, J. I. (Univ. of Connecticut, Farmington). pp 274-313 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

The following topics are reviewed, cell population kinetics; cell cycle; tissue doubling time; cell loss in tumors; growth fraction in tumors; clinical studies; sites of cellular proliferation; rates of cell proliferation; duration of DNA synthesis in human tissues; and RNA synthesis in proliferating tissues. Experimental studies using tritiated thymidine are described for cell labeling as a function of zone of incorporation and as a function of time. (HLW)

24542 CELL KINETIC STUDIES OF SIX SQUAMOUS CARCINOMAS IN HUMAN BEINGS. Bresciani, F.; Morelli, G.; Guandalini, S.; Ziparo, E. (Univ., Naples). pp 314-332 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C Thomas (1974).

From conference on the biological and clinical basis of tumor radiosensitivity; Rome, Italy (7 Oct 1971). See CONF-711036-.

After intracarotid injection of 2 mCi of tritiated thymidine, there is a sharp pulse of label lasting about thirty minutes in tumors of tributary region. From this pulse a labeling of cells in DNA synthesis results, which is satisfactory for autoradiographic studies. By means of successive biopsies and autoradiography of their squash preparations, fraction of labeled mitoses curves were obtained for six squamous cell carcinomas of skin of head, lip and gum. One of the tumors was re-investigated while rapidly regrowing after partial destruction by methotrexate. Some of the fraction of labeled mitoses curves show atypical features and their analysis might be subject to refinement. By an improved manual method, DNA synthesis time and intermitotic time were derived from the curves. On the basis of interphase cell labeling index, also growth fraction, cell birth rate and cell loss rate were estimated. In the six tumors, DNA synthesis time was found to vary from 16 to 36 hours; intermitotic time from 48 to 80 hours; interphase labeling index from 15 to 38 percent; growth fraction from 34 to 70 percent; birth rate from 44 to 141 cells produced per hour and 10,000 cells in tumor; cell loss rate, from 76 to 96 percent of birth rate. Doubling time of the tumors was also assessed by repeated measurements of tumor volume during a two- to three-week period of clinical work-up (and cell kinetic study) before therapy. A significant correlation appears to exist between doubling time and cell kinetics parameters; at least within the limited sample of squamous cell carcinomas under consideration. The statement can be made that a tumor of this type grows faster because of concurrence of three factors: a shorter cell cycle, a higher growth fraction and a smaller cell loss. The above relationship also applies to the same tumor growing at an increased rate after partial destruction by chemotherapy. (auth)

MATERIALS

24543 (UCRL-50028-75-1) H-DIVISION QUARTERLY REPORT, JANUARY-MARCH 1975. (California Univ., Livermore (USA). Lawrence Livermore Lao.). 1975. Contract W-7405-Eng-48. 42p. Dep. NTIS $4.00.

Research progress is reported in six sections. (JRD)

For abstracts of individual sections see: 24267, 24319, 24326, and 24649-24651.

Ceramics and Cermets

Refer also to abstracts 24142, 24166, 24167, 24173, 24315, 24623, 24634, 24640, 24657, 24675, 24676, 24690, 25251, 25264, and 25273.

24544 (ORNL-TM-4989) EFFECTS OF PROCESSING VARIABLES ON HTGR FUEL KERNELS FABRICATED FROM URANIUM-LOADED CATION-EXCHANGE RESIN. Johnson, D. R.; Lackey, W. J.; Sease, J. D. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 28p. Dep. NTIS $4.00.

An experiment was performed to determine whether the process for refabricating HTGR fuel kernels could be reasonably controlled if scaled up to batches of 500 g U in a 5-in. ID (0.13-m) microsphere coating furnace. The effects of gas flow rate, heating rate, and resin conversion temperature and time on the composition, size, shape, and density of the fuel kernels were determined in a statistically designed and analyzed experiment. Based on these results, the uncertainties in predicted values of the fuel kernels at 95 percent confidence are as follows: percent conversion to UC_2, +-15 percent; percent diametral shrinkage, +-2.8 percent; and particle density, +-0.04 g/cm^3. These 95 percent confidence intervals for predicted values can be reduced in magnitude via more experimental data. The process can be controlled within acceptable limits in engineering-scale equipment. (auth)

24545 (PB-239607) REFRACTORY MATERIALS FOR COAL-FUELED MHD POWER GENERATION. Progress Report No. 4, 1 July 1973-31 December 1973. (Utah Univ., Salt Lake City (USA). Div. of Materials Science and Engineering). May 1974. 30p. (UTEC-MSE-74-068). NTIS $3.75.

The problem is to develop better materials for the preheater and MHD duct for a coal-fueled MHD power generator, used as a topping unit on a central station power plant. Experimental work has continued during this reporting period on the slag corrosion resistance of refractory materials which may be used in MHD preheater units. The effort has involved building new equipment and upgrading equipment already on hand, finding more suitable crucible materials for containment of the slag, improvement of the slag preparation technique, preparation of corrosion specimens, and continuation of corrosion studies. Materials tested were magnesite, chrome-magnesite, silicon carbide and A123 brick. Preparation of La(1-x)Sr(x)Cr03 electrodes is described. (GRA)

24546 (RDT-M-6-6T(8-75)) HIGH-STRENGTH, HIGH-TEMPERATURE BOLTING MATERIALS, (ASME SA-453 WITH ADDITIONAL REQUIREMENTS). (Atomic Energy Commission Combined Operations Planning, Oak Ridge, Tenn. (USA)). Aug 1975. RSO.

This standard covers bolting material (bars, bolts, screws, studs, stud bolts) for nuclear and associated applications. The additional requirements and optional provisions include testing, examination by ultrasonic and other means, Charpy V-notch, grain size, etc. (DLC)

24547 (SAND-75-5081) THERMODYNAMICS OF THE URANIUM (ALPHA, BETA AND GAMMA PHASES)-HYDROGEN SYSTEM. Northrup, C. J. M. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 8p. (CONF-750915-6). Dep. NTIS $4.00.

From 5th international conference on plutonium and other actinides; Baden-Baden, F.R. Germany (10 Sep 1975).

Pressure-composition isotherms have been obtained for the uranium-hydrogen system over the pressure range from 0.1 to 680 atmospheres at temperatures ranging from 450 to 846°C. The hydride (delta) was formed from high purity uranium and pressure-temperature plots were obtained for the broken bracket U/sub alpha/, delta broken bracket, broken bracket U/sub beta/, delta broken bracket, broken bracket U/sub gamma/, delta broken bracket two phase regions. Results of investigation indicate that in contrast to the work of Chevallier, Spitz, and Blum [Chevallier et al., Acad. Sci., 264: 96(1967)], the uranium-hydrogen system retains broad, flat, two phase plateaus on the pressure-composition isotherms to temperatures as high as 846°C. The effect of oxygen impurities is noted and it was found that the enthalpy of formation of the hydride from pure uranium was -28.9 kcal mol^{-1}. The three dimensional phase diagram for the system is discussed and the gas-liquid, gas-solid interface is given delineating the known phase boundaries. (auth)

24548 (UCRL-51865) ISOTHERMS FOR THE U-UH_3-H_2 SYSTEM AT TEMPERATURES OF 700°-1050°C AND PRESSURES TO 137.9 MPa. Lakner, J. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jul 1975. Contract W-7405-Eng-48. 28p. Dep. NTIS $4.00.

A new pressure system utilizing a heated internal pressure vessel was used to obtain pressure vs composition isotherms for the U-H system over the range 700 to 1050°C at pressures up to 137.9 MPa (1361 atm). The experimentally determined "plateau" pressures are compared with values extrapolated from lower temperatures and pressures previously obtained by other workers. The current investigation shows that, in contrast to the work of Chevalier, et al., the U-H system retains broad two-phase plateaus at temperatures as high as 1050°C. (19 fig) (auth)

24549 STRUCTURE OF THE SUBNITRIDE Ta_8N AND $Ta_{38}N_5$ BY MEANS OF ELECTRON MICROGRAPHS. Ortiz, C.; Steeb, S. (Max-Planck Institut fuer Metallforschung, Stuttgart). J. Less-Common Met.; 42: No. 1, 51-58(Aug 1975). (In German).

Substructure diagrams were obtained by means of electron diffraction (50 kV) from electrolytically thinned specimens of tantalum which were treated isobarically and isothermally at 310 to 390°C and 5×10^{-4} torr nitrogen. Evaluation of the diagrams indicated tetragonal distorted superstructure cells with $4\alpha_{Ta} \times 4\alpha_{Ta} \times (4 \times 1.006\alpha_{Ta})$ in the case of Ta_8N, and $6\alpha_{Ta} \times 6\alpha_{Ta} \times (2 \times 1{,}04\alpha_{Ta})$ in the case of $Ta_{38}N_5$. By the use of Patterson synthesis the distribution of nitrogen atoms within these cells has been determined. The mean atomic volumes fit well in a plot of mean atomic volumes versus concentration for the different phases in the Ta-N system. The morphology was determined from transmission electronmicrographs. The subnitride Ta_8N shows a tweed-like pattern, whereas the subnitride $Ta_{38}N_5$ shows relatively large deposits. (auth)

24550 THERMAL BEHAVIOR OF R-Nb_2O_5 AND STRUCTURAL RELATIONS OF V_3MoO_{10} AND $V_5W_3O_{20}$. Plies, V.; Gruehn, R. (Justus Liebig Univ., Giessen, Ger.). J. Less-Common Met.; 42: No. 1, 77-88(Aug 1975). (In German).

The thermal behavior of R-Nb_2O_5, V_3MoO_{10}, $V_5W_3O_{20}$ as well as of P-Nb_2O_5 (which is partially derived from R-Nb_2O_5 at 630°C) has been investigated with a high-temperature x-ray camera (as developed by Simon) up to 950°C. If R-Nb_2O_5 is heated up slowly it undergoes a thermal transition to P-Nb_2O_5; this is favored by P-Nb_2O_5 initially present; further heating converts the resulting P-Nb_2O_5 into N-Nb_2O_5. If the temperature is rapidly increased and is followed by annealing for several hours, a thermal transition of R-Nb_2O_5 to N-Nb_2O_5 takes place. At high temperature the phases V_3MoO_{10} and $V_5W_3O_{20}$ analogous to R-Nb_2O_5 show no phase transitions, e.g., to a structure analogous to P-Nb_2O_5. In contrast to R-Nb_2O_5, the phases V_3MoO_{10} and $V_5W_3O_{20}$ exhibit a strongly anisotropic thermal lattice expansion in the direction of [001]. This expansion is similar to that of the V_2O_5 phase. (auth)

24551 MASS SPECTROMETRIC DETERMINATION OF THE THERMODYNAMIC STABILITIES OF GASEOUS MOLYBDENUM OXIDES AND SODIUM MOLYBDATES AND PREDICTED STABILITIES OF GASEOUS GROUP IA TUNGSTATES, MOLYBDATES, CHROMATES, AND SULFATES. Choudary, U. V.; Gingerich, K. A.; Kingcade, (Texas A and M Univ., College Station). J. Less-Common Met.; 42: No. 1, 111-126(Aug 1975).

During the mass-spectrometric investigation of the Na-O-P system in molybdenum crucibles, in addition to the gaseous molybdenum oxides, MoO, MoO_2 and MoO_3, gaseous sodium molybdates (V and VI) and molybdite (IV) have been identified and their stabilities determined. From the enthalpy changes for the isomolecular reactions involving the gaseous species $NaPO_2$, $NaPO_3$, $NaMoO_3$, Na_2MoO_3, Na_2MoO_4, MoO_2 and MoO_3, the standard heats of formation, and atomization energies at 298°K in kcal mol^{-1} have been derived as -128.1 ± 8, 489.8 ± 8 ($NaMoO_3$); -175.0 ± 14, 562.3 ± 14 (Na_2MoO_3); -257.3 ± 12, 704.4 ± 12 (Na_2MoO_4). By combining the enthalpy change of the pressure-independent reaction involving the gaseous molybdenum oxides MoO, MoO_2, and MoO_3, with the selected values of JANAF thermochemical tables for standard heats of formation of MoO_2(g) and MoO_3(g), revised values

have been obtained for the dissociation energy (145.1 ± 8 kcal mol^{-1}) and standard heat of formation (71.8 ± 8 kcal mol^{-1}) of MoO(g) at 298°K. By comparing the stability trends in condensed and gaseous hydrogen and alkali metal tungstates, molybdates, chromates and sulfates, the atomization energies of the gaseous compounds of alkali metals at 298°K have been recommended as 767 ± 12 (tungstates), 708 ± 12 (molybdates); 620 ± 12 (chromates) and 597 ± 6 (sulphates) kcal mol^{-1}. (auth)

24552 RESEARCH ON SEMICONDUCTOR GLASSES. I. Raman Vibrational and Ultraviolet Studies on Semiconductor Vitreous Materials of the $As_2O_3-V_2O_5-PbO$ System. Bertoluzza, A.; Simoni, R.; Monti, P. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Nat.; 55: No. 5, 477-490(Nov 1973). (In Italian).

Vibrational spectra of binary glassy materials As_2O_3-PbO (Raman and uv), V_2O_5-PbO (uv) and $As_2O_3-V_2O_5$ (uv) are reported and discussed. In the case of As_2O_3-PbO systems, spectra interpretation suggests a modification of As_2O_3 and V_2O_5 structures and the formation of structural centers typical, respectively, of metaarsenites and metavanadates. For these demolitions, the probable mechanisms are proposed. In the case of $As_2O_3-V_2O_5$ system (64 to 30% As_2O_3), the spectra agree with the ortho-, pyro-, metavanadates formation hypothesis together with a V_2O_5 little modification, while for the same system (30 to 10% As_2O_3) the spectra are not in disagreement with the supposed presence of V^{+4} species. (auth)

24553 RESEARCH FOR NEW SUPERCONDUCTING MATERIALS. Di Salvo, F. J. (Bell Labs., Murray Hill, NJ). pp 205-220 of Applications of Cryogenic Technology. Vol. V. Carr, R. H. (ed.). Whitestone, NY; Scholium International, Inc. (1973).

From 5th annual conference of the Cryogenic Society of America; Chicago, Illinois, USA (3 Oct 1972). See CONF-721023-.

Research on superconductors is reviewed. Information is included on the history of superconductivity, classes of superconductors, electron-phonon mechanism of superconductivity, properties of transition element dichalcogenides, and other intercalation compounds. (JRD)

24554 MEANS FOR EFFECTING FLUIDIZATION IN PYROLYTIC CARBON COATING PROCESSES. Lackey, W. J. Jr.; Sease, J. D. (to U. S. Energy Research and Development Administration). US Patent 3,889,631. C23c13/08. 17 Jun 1975. Filed date 18 Mar 1974. 11p.

PAT-APPL-452,166.

An improved gas distribution means, which has utility in fluidized bed coaters for depositing pyrolytic carbon, is described. It consists of a plurality of gas-permeable regions within a supporting matrix comprising a relatively thick dimension for structural rigidity and relatively thin sections to inhibit clogging due to decomposition products of the fluidizing gas. A second gas distribution means feeds gas into a plenum below said first gas distribution means to insure a uniform pressurized zone of gas which serves as feed to said gas-permeable regions. (auth)

24555 OXYNITRIDE FUEL KERNEL FOR GAS-COOLED REACTOR FUEL PARTICLES. Leitnaker, J. M.; Lindemer, T. B. (to U. S. Energy Research and Development Administration). US Patent 3,878,041. G21c3/06; C21c3/20. 15 Apr 1975. Filed Date 8 Aug 1973. 9p.

PAT-APPL-386,657.

A nuclear fuel for use in gas-cooled reactors comprising a carbon coated kernel of UO/sub 2-r/N/sub 3/4 x/ where 0 less than x less than or equal to 1 is described. (auth)

24556 ALUMINUM TITANATE CRUCIBLE FOR MOLTEN URANIUM. Asbury, J. J. (to U. S. Energy Research and Development Administration). US Patent 3,890,140. C22b61/04. 17 Jun 1975. Filed date 10 May 1973. 6p.

PAT-APPL-359,052.

An improved crucible for molten uranium is described. The crucible or crucible liner is formed of aluminum titanate which essentially eliminates contamination of uranium and uranium alloys during molten states thereof. (auth)

24557 POINT DEFECTS IN HEXAGONAL BORON NITRIDE. II. Theoretical Studies. Zunger, A. (Soreq Nuclear Research Center, Yavne, Israel); Katzir, A. Phys. Rev., B.; 11: No. 6, 2378-2390(15 Mar 1975).

Substitutional and displaced carbon impurities and an isolated nitrogen vacancy in hexagonal boron nitride are theoretically investigated by the "small periodic cluster" approach. The perfect-solid band structure is calculated from the solution of the eigenvalues of a finite and periodic cluster of atoms arranged according to the known crystal structure. The linear combination of atomic orbitals representation of the crystal orbitals is adopted and semiempirical MO (molecular orbital) methods (extended Huckel, iterative extended Huckel) are used for the solution of the electronic eigenvalue problem. Point-defect problems are then treated by introducing the impurity atom or the vacant site into the otherwise perfect periodic cluster, and repeating the solution. Lattice relaxations are introduced around the defect site and charge redistribution among the cluster atoms is allowed for via self-consistent MO treatment. For a substitutional carbon impurity defect, it is observed that two deep defect levels, mainly localized on the carbon atom, appear (3.2 to 4.9 eV below the conduction band). Another level splits from the conduction band as the carbon atom is raised from the layer plane in a perpendicular direction. This level, 1.0 to 1.3 eV below the conduction band, has a symmetrical charge distribution on the three boron atoms surrounding the impurity site. As the distance of the carbon atom from the layer plane is increased to infinity, a nitrogen vacancy is formed. It is characterized by a defect level 1.1 to 1.4 eV apart from the conduction-band edge which also possesses a three-boron character. Lattice relaxations were shown to stabilize these defects. The findings agree semiquantitatively with the experimental results on these defects. (auth)

24558 VYSOKOTEMPERATURNYE KARBIDY. (High-Temperature Carbides). Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). 192p.

A compilation of 36 articles on studies of new methods for obtaining carbides, investigations of the physical, physical-chemical, thermodynamic, and mechanical properties, and research on their electron structure and the nature of the chemical bonds in these compounds is presented. Separate abstracts were prepared for 21 articles. (JSR)

For abstracts of individual papers see: 24559–24579.

24559 CLASSIFICATION OF CARBIDES. Samsonov, G. V.; Kosolapova, T. Ya. pp 5-13 of Vysokotemperaturnye karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian).

The chemical properties of metal carbides were examined according to their grouping in the periodic table and on this basis a classification system for carbides was proposed. An analysis was made of the character of the interaction of metals and non-metals with carbon. Principles, examining the probability of carbide formation, were derived. A general classification, based on the capacity of the corresponding metals and non-metals to exhibit donor or acceptor qualities with respect to C, was proposed. (13 references) (tr-auth)

24560 PRECIPITATION OF THE CARBIDES OF Zr AND Nb FROM THREE-REAGENT GASEOUS MIXTURES. Gorda, V. P.; Kuznetsov, E. A. pp 19-38 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian).

The regularities in the formation of the carbides of Zr and Nb from three-reagent gaseous mixtures were studied. As a result of the microscopic examination of precipitates of Zr and Nb carbides, the optimum conditions for their formation in order to obtain high-quality precipitates which were dense, homogeneous, and with a fine-crystalline structure were determined. The kinetics of the carbide precipitation process were studied. The order of the reaction according to the reagents of the mixture and the temperature of the true rate constant were determined in the interval from 1100 to 1600°C. (tr-auth)

24561 CONDUCTIVITY BANDS OF MONOCARBIDES OF METALS OF IVa AND Ia SUBGROUPS. Gel'd, P. V.; Tskhai, V. A.; Borukhovich, A. S.; Dubrovskaya, L. B.; Matveenko, I. I. pp 40-45 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

On the basis of the calculated structure of the energy spectra of equiatomic carbides and available experimental data, the possible mechanisms for the scattering of carriers in non-stoichiometric monocarbides were examined. NbC_x, TaC_x, and VC_x are among the carbides discussed. (tr-auth)

24562 THERMAL EXPANSION OF TiC, ZrC, AND NbC IN THEIR HOMOGENEITY REGION. Samsonov, G. V.; Klochkov, ... A.; Timofeeva, I. I. pp 46-48 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The lattice constants of the monocarbides of Ti, Zr, and Nb were determined by x-ray methods in the homogeneity region in the temperature interval from 20 to 900°C. The coefficient of thermal expansion was calculated for each of the carbides. (tr-auth)

24563 CHARACTER OF THE EVAPORATION OF TERNARY SOLID SOLUTIONS IN VACUUM. Nikol'skaya, T. A.; Avarbe, R. G. pp 58-64 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The conditions for the congruent evaporation in a vacuum from

open surfaces of ternary solid alloys of two types were examined: metal(1)–metal(2)–non-metal (Me'–Me''–X) and metal–non-metal(1)–non-metal(2) (Me–X'–X''). It was shown that congruent evaporation of systems of the Me–X'–X'' has little probability. A simple criterion was proposed for the evaluation of the possibility of congruent evaporation of the Me'–Me''–C system. On the basis of this criterion the possibility of congruent evaporation was evaluated for 15 ternary carbide alloys of Ti, Zr, Hf, V, Nb, and Ta. It was shown that only the Nb–Hf–C system is of interest in this respect. (tr-auth)

24564 KINETICS OF THE RECRYSTALLIZATION GRAIN GROWTH IN ZIRCONIUM CARBIDE. Danisina, I. N.; Avarbe, R. G. pp 70-73 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The process of recrystallization grain growth in zirconium carbide was investigated. It was established that the diffusion processes of grain growth and a series of other relations for this metal-like compound have the same character as that of typical metals. The time dependence of grain growth was established for the carbide with the composition $ZrC_{0.85 \pm 0.05}$. The equation for the rate of grain growth was determined. (tr-auth)

24565 STRUCTURE AND PROPERTIES OF BORON CARBONITRIDES. Prilutskii, E. V.; Makarenko, G. N.; Serebryakova, T. I. pp 84-89 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The conditions for the preparation of boron carbonitrides of variable composition were studied. Chemical and x-ray structural analyses were made of the reaction products. The ir absorption spectra, diffuse reflection spectra, and the oxidation of samples of different composition were studied. On the basis of the studies made it was proposed that boron carbonitrides represent solid solutions of graphite in boron nitride with the tentative formula BNC_{1-x}. The laminated structure of boron carbonitride is the origin of all its properties. (tr-auth)

24566 ALLOYS OF THE TERNARY Hf–Mo–C SYSTEM. Eremenko, V. N.; Velnikanova, T. Ya.; Shabanova, S. V. pp 90-96 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The structure of alloys of the Hf–Mo–C system was studied in the high temperature region from 2000°C up to the temperature for the initiation of melting. It was shown that a continuous series of solid solutions $(Mo, Hf)C_{1-x}$ are formed close to the surface of the solidus. In the solid state all phases of the Hf–Mo–C system enter into equilibrium with these solid solutions. A strong relative enrichment of the carbide phases with Hf was observed. (tr-auth)

24567 PHASE COMPOSITION AND SOME PROPERTIES OF ALLOYS OF THE Si–B–C SYSTEM ADJACENT TO THE SILICON CARBIDE–B CROSS SECTION. Kalinina, A. A.; Sokhor, M. I. pp 96-99 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

Alloys of the indicated part of the phase diagram of Si–B–C were prepared by a single hot pressing, by a double hot pressing with subsequent lengthy homogenization, or by double hot pressing with homogenization and subsequent sintering under high pressure and heat. The following phases were observed in the alloys: solid solutions based on silicon carbides of the cubic and hexagonal modifications, solid solutions based on Si, and solid solutions based on boron carbide. The basic components of the alloys are silicon carbide-based solid solutions of B. The microhardness of this component does not exceed 3430 kg/mm^2. (tr-auth)

24568 THEORETICAL ANALYSIS OF HOMOGENIZATION PROCESSES OF DISPERSE MIXTURES OF THE PSEUDOBINARY SYSTEM TiC–ZrC DURING SINTERING AND HOT PRESSING. Ogorodnikov, V. V.; Sverdlik, N. N. pp 100-101 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

A method for the calculation of the distribution of the alloys with respect to concentration was examined. It is based on a fcc model of the dispersed mixture. A very simple method based on the introduction of an approximation of the plane diffusion front in the elementary volume was proposed. An analysis is given of the homogenization process of TiC–ZrC mixtures according to the change of the concentration distribution, the fraction of an alloy of given concentration, the Fisher homogeneity criteria, and the maximum and minimum concentrations in the alloy. A comparison is made of the theoretical and experimental data. (tr-auth)

24569 COMPACTING AND HOMOGENIZATION PROCESSES IN DISPERSE MIXTURES OF THE PSEUDOBINARY SYSTEM TiC–ZrC DURING SINTERING AND HOT PRESSING. Ogorodnikov, V. V.; Sverdlik, N. N. pp 106-108 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka(1975). (In Russian)

The effect of the composition of the alloys of the system on the density of the hot pressed samples was studied. The character of the microstructure after sintering and hot pressing was studied and a quantitative evaluation was made of the degree of homogeneity on the basis of x-ray and micro x-ray spectral analysis and the measurement of the electroconductivity. It was shown that the compacting of the TiC–ZrC mixture during hot pressing proceeds much easier than with the pure carbides. The reverse effect was observed during sintering. The microstructure of the hot pressed samples is single phased. In sintered samples the decomposition of the solid solution with formation of the eutectoid was observed. The mechanism for the effect of the heterodiffusion on the compacting of the TiC–ZrC mixture during sintering and hot pressing was discussed. (JSR)

24570 SOLUBILITY OF CARBIDES OF THE ELEMENTS OF GROUP IV AND V IN AUSTENITIC STEELS OF DIFFERENT COMPOSITION. Gol'dshtein, M. I.; Panfilova, L. M.; Syreishchikova, V. I.; Zel'dovich, E. S.; Fedorus, V. B. pp 119-121 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The solubility of carbides of the refractory metals Ti, V, Nb, and Mo in austenitic steels of different composition was studied by chemical analysis, electron microscopy, electrography, and x-ray structural analysis. The temperature regions of solubility, and the equilibrium conditions of the carbides in the austenite were established. It was shown that the composition of the austenite has a substantial effect on the transition of the carbides into the austenite. (JSR)

24571 INTERACTION OF BORON CARBIDE WITH OXIDES OF TITANIUM AND ZIRCONIUM. Marek, E. V.; Makarenko, G. N. pp 122-124 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The interaction of boron carbide with oxides of Ti and Zr was investigated. According to the x-ray analysis data, the presence of three phases was detected in the alloys: boron carbide, diboride of Ti or Zr, and graphite. Results of measurements showed that the values of the microhardness of the phase are increased somewhat and amount to 6700 to 7000 kg/mm^2 for B_4C-based phases (B_4C–TiB_2 system). The results of the measurement of the temperature pattern of the electric resistance of the alloys showed that in the alloys the semiconductor character of the conductivity is maintained in all the concentration intervals studied. The stability of the alloys during oxidation in air was investigated. (JSR)

24572 FORMATION OF INTERMEDIATE PHASES IN W–SiC–Ti COMPOSITIONS DURING ANNEALING. Dzyadykevich, Yu. V.; Burykina, A. L. pp 133-135 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The interaction of SiC wires with W substrates and Ti matrices at 900°C for 300 h was studied by metallography and micro x-ray spectral and microdurometric analyses. It was established that the SiC wires do not interact with the W substrate. In the contact zone of the SiC wire with the Ti matrix the phase Ti_3Si is formed. (tr-auth)

24573 INTERACTION OF POWDERS OF NIOBIUM CARBIDE AND SILICON. Kutysheva, E. V.; Kuz'ma, Yu. B. pp 135-139 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The interaction of NbC with Si was studied in a vacuum in the temperature interval from 900 to 1900°C. The experimental results were evaluated from the data of x-ray and chemical phase analyses. The latter was developed on the basis of data on the solubility of NbC and Si, $NbSi_2$, and SiC. The thermodynamic analysis of the NbC–Si system showed that the most probable reaction is the formation of $NbSi_2$ and SiC. It was shown that the interaction proceeds with the formation of the β modification of these two compounds at all temperature intervals. (tr-auth)

24574 INTERACTION OF CARBIDES OF THE TRANSITION METALS OF THE IV–VI GROUPS WITH SILICON. Kutysheva, E. V. pp 139-142 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The interaction of the carbides of Zr, Nb, and Mo with Si was studied in a vacuum in the temperature interval from 900 to

1900°C. It was shown that metallic silicides and β-SiC are the interaction products. The reaction proceeds according to the scheme $MeC + Si \rightarrow Me_xSi_y + SiC$. The reaction of ZrC with Si begins at 800°C, and the interaction of NbC with Si begins at 1000°C. The stability of the carbides with respect to Si increases in the series $ZrC \rightarrow Mo_2C \rightarrow NbC$. (tr-auth)

24575 HIGH TEMPERATURE OXIDATION OF CARBIDES OF THE TRANSITION METALS OF THE IV–VI GROUPS. Voitovich, R. F.; Pugach, E. A. pp 143-156 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The high-temperature oxidation of the carbides of Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, and W in air was studied in the temperature interval from 600 to 1200°C. It was shown that the most thermodynamically possible reactions of the carbides with air are those reactions whose products contain free C and oxides and nitrides of the respective elements. The oxidation mechanism for the carbides is determined by the singularities of the defect structure, the physico-chemical prooperties of the metal oxides, and by the participation of C in the oxidation process. (tr-auth)

24576 CORROSION–ELECTROCHEMICAL BEHAVIOR OF MOLYBDENUM CARBIDE IN ACID MEDIA. Neiman, N. S.; Knyazheva, V. M.; Kolotyrkin, Ya. M.; Plaskeev, A. V.; Rodin, N. N.; Dembrovskii, M. A. pp 156-164 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The corrosion-electrochemical behavior of Mo_2C in highly aggressive media (boiling 20% HCl and 50% H_2SO_4) was studied. The kinetics of the dissolution of Mo_2C was studied at different potentials. The dependences of the steady rate of its dissolution on the potential were constructed. The results obtained led to the assumption that complex carbides and other phases, enriched in Mo, must be subjected to selective etching at the limits of the passive range of alloys and steels, whose high corrosion resistance is based on the capacity for an easy transition to the passive state. (tr-auth)

24577 SOLIDS WITH A BORON CARBIDE BASE. Makarenko, G. N.; Marek, E. V. pp 165-173 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The conditions for the preparation of alloys of boron carbide alloyed with Ti, Zr, and Hf were studied. Chemical, x-ray, and metallographic analyses were made and the microhardness, microfragility, and coefficient of thermal expansion were measured for these alloys. It was shown that the boron carbide-based alloys with additions of Ti have increased hardness (~7000 kg/mm^2) and significantly less fragility than pure B_4C. The alloys developed were used as indenters for the measurement of the hot hardness of materials in the temperature interval from 300 to 2000°C. (tr-auth)

24578 PROPERTIES OF ALLOYS OF THE NbC–WC SYSTEM. Kindysheva, V. S.; Mal'tseva, L. F.; Kotlyar, E. E. pp 173-176 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

Alloys of the NbC–WC system were prepared. A method was developed for the determination of the Nb and Mo in the alloys and the chemical properties of the alloys were determined. Metallographic and x-ray structural analyses were made after extended heating in a vacuum. The density, microhardness, lattice parameters, and rate of weight loss during extended heating in a vacuum in the temperature interval from 2000 to 2400°C were measured. (tr-auth)

24579 CHEMICAL PROPERTIES OF OXYCARBIDES OF Ti AND Zr. Kutysheva, E. V.; Fedorus, V. B. pp 176-179 of Vysokotemperaturnye Karbidy. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1975). (In Russian)

The chemical stability of the oxycarbides of Ti and Zr of different composition in aggressive media was studied. It was established that the substitution of a C atom by an O atom up to 39 at.% O in Ti oxycarbides does not affect their properties during interactions with oxidants and solutions of reagents not having oxidizing properties. The substitution of C atoms with O atoms in Zr oxycarbides does not essentially change their properties. (tr-auth)

24580 ELEKTRONNOE STROENIE I FIZICHESKIE SVOISTVA TVERDOGO TELA. Chast' 2. (Electron Structure and Physical Properties of Solids. II). Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). 168p.

A collection of 11 articles on oxides and chalcogenides and 16 articles on compounds of the transition metals with the nonmetals C, B, N, Si, Ge, Se, and P were compiled. Individual abstracts were prepared for 18 of the articles. (JSR)

For abstracts of individual papers see: 24581–24596, 24640, and 24661.

24581 INTERACTION OF RARE EARTH OXIDES WITH MAGNESIUM AND BARIUM OXIDES. Ogorodnikova, A. A.; Maister, I. M.; Lugin, L. I.; Lopato, L. M. (Inst. of Problems in Materials Science, Kiev). pp 3-9 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

From data on high-temperature differential thermal analysis, and x-ray and microstructural studies it was possible to construct phase diagrams for the systems Pr_2O_3–MgO, Yb_2O_3–MgO, Pr_2O_3–BaO, and La_2O_3–BaO. These systems are characterized by by the formation of an incongruently melting compound having a 1:1 composition, and by the presence of solid solutions with the rare earth oxide as a base. The maximum solubility in lanthanum oxide at a temperature of 1830°C was 18 mol% which decreased to 14 mol % at a temperature of 1500°C. The solubility of barium oxide decreases in the series of oxides from La to Nd. (SJR)

24582 POLYMORPHOUS CONVERSION OF SOLID SOLUTIONS IN THE ZrO_2–HfO_2 SYSTEM. Sukharevskii, B. Ya.; Gavrish, A. M.; Zoz, E. I.; Solov'eva, A. E. (Physical-Technical Inst. of High Temperatures, Kharkov). pp 9-17 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

The change in free energy of a single-component system during formation of nuclei of a new phase is conditioned by the appearance of phase separation boundaries and structural stresses associated with the jump in volume of nuclei during the transition. A thermodynamic analysis of the changes taking place shows that in the case when a polymorphic conversion of a solid solution is accompanied by a change in the chemical composition, the work of formation of critical nuclei of a new phase is decreased by a certain amount. If this advantage is large in comparison with the barrier limiting diffusion, then a diffusion mechanism is realized for the transition. If the advantage is small or diffusion is suppressed, than a diffusion-free (martensitic) type of transition is accomplished, if allowed by the crystal-geometric characteristics of the phases. X-ray studies on 100 ZrO_2, 30 mol % HfO_2, and 70 mol % HfO_2 showed that there were changes in the chemical composition of the monoclinic solid solution during the polymorphic conversion from the alpha to beta form. This transformation has all the external signs of a martensitic transition, but it cannot be considered as purely martensitic, at least at high temperatures, because of the change in composition of the phases at the transition. (SJR)

24583 EFFECT OF VACANCIES ON THE FORMATION OF NUCLEI OF A NEW PHASE DURING THE POLYMORPHIC CONVERSION OF ZIRCONIUM DIOXIDE. Sukharevskii, B. Ya.; Gavrish, A. M. (Physical-Technical Inst. of Low Temperatures, Kharkov). pp 17-24 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

A change in concentration of a second component (impurity atoms or vacancies) during formation and growth of the nuclei of a new phase in the course of a polymorphic conversion leads to a decrease in the work of formation of the nuclei. With a constant concentration of vacancies at any temperature, any change in vacancy concentration will take place by a redistribution of vacancies between the matrix phase and the nucleated phase. A nonequilibrium distribution of anion vacancies was created by heating ZrO_2 to about 1500°C and then quenching the ZrO_2 samples. Variations in the kinetics and temperature characteristics of the polymorphic conversion of ZrO_2 were attributed to the formation of vacancies in the nuclei of the new phase being formed during the polymorphic transition. (SJR)

24584 REDUCTION OF ZIRCONIUM DIOXIDE AND OF SOLID SOLUTIONS BASED ON ZrO_2. Kuznetsov, A. K.; Tikhonov, P. A.; Keler, E. K. (Inst. of Silicon Chemistry, Leningrad). pp 31-36 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

A comparative study is made of the vacuum and electrolytic reduction of ZrO_2 samples containing Y_2O_3 additives. It was established that on reducing ZrO_2 and its solid solutions, a nonstoichiometric phase containing oxygen defects is first formed. Then with further electrolytic reduction a "metallic" phase, which results in a sharp change of the material's properties, is formed along with the nonstoichiometric oxide phase. On heating the reduced samples in air the "metallic" phase is oxidized with a loss in "metallic" conductivity, an increase in weight, and expansion and disordering of the material. (SJR)

24585 RADIATION STABILITY OF THE CERAMICS BeO AND AlN DURING REACTOR IRRADIATION. Khudyakov, A. V.

(Scientific-Research Inst. of Atomic Reactors, Melekess, USSR). pp 48-53 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972. (In Russian)

As neutron reflectors and moderators, it is necessary to use materials having high electrical and mechanical strength, good thermal conductivity, and good heat strength. BeO and AlN may be the most suitable for these purposes. Data on the radiation stability of BeO are reviewed and compared with the radiation data available on AlN. Anisotropic expansion and swelling is noted during low-temperature irradiation at ~100°C. At 300°C the linear expansion of articles irradiated at an integral flux of 5×10^{20} neutrons/cm^2 decreases by a factor of two, and at 900°C there is no expansion in the crystal lattice parameters. Thus increasing the radiation temperature of AlN should increase its radiation stability. It is necessary to investigate carefully possible processes of pore formation in AlN during high-temperature irradiation, and the effect of thermal, mechanical, and electrical stresses on pore formation and migration. A study should be made of the possibility of using samples with the grains directed along the C axis with respect to the field of thermal and electrical stresses. (SJR)

24586 MAGNETIC PROPERTIES OF CUBIC MONOCARBIDES OF GROUP IV AND V TRANSITION METALS OF THE PERIODIC TABLE. Borukhovich, A. S.; Dubrovskaya, L. B.; Matveenko, I. I.; Gel'd, P. V. (Inst. of Chemistry, Sverdlovsk, USSR). pp 76-82 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

The study presents magnetic susceptibilities of cubic monocarbides of zirconium (ZrC_x), vanadium (VC_x), niobium (NbC_x), and tantalum (TaC_x) within the limits of their homogeneity regions in the temperature interval from 20 to 1300°K. For all defect monocarbides the magnetic susceptibility increases with increasing temperature. Only for materials saturated with carbon ($NbC_{0.98}$ and $TaC_{0.97}$) is a decrease in magnetic susceptibility observed with a rise in temperature. (SJR)

24587 ROENTGENOGRAPHIC STUDY OF FEATURES OF THE INTERATOMIC INTERACTION OF COMPONENTS IN THE HIGHER CARBIDE OF VANADIUM. Arbuzov, M. P.; Fak, V. G.; Khaenko, B. V. (Inst. of Problems in Materials Science, Kiev). pp 82-88 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

A careful measurement was made of the absolute intensity of the main reflections in the higher vanadium carbide having a composition of $VC_{0.88}$. The interaction of components in vanadium carbide leads to a decrease in scattering angles. These data indicate an ordered arrangement of vacancies in the elementary cell. (SJR)

24588 RELATION OF THE PHYSICAL-MECHANICAL PROPERTIES OF MELTS BASED ON REFRACTORY COMPOUNDS TO THEIR CRYSTALLINE AND ELECTRON STRUCTURE. Oreshkin, V. D.; Svetlopolyanskii, V. I.; Repkin, Yu. D. (Volgograd Pedogogical Inst., USSR). pp 89-93 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

Values of hardness and microhardness are tabulated for B_4C, SiC, Cr_3C_2, $(Ti,Cr)B_2$, 50% TiB_2 + 50% W_2B_5, 50% CrB_2 + 50% W_2B_5, and 50% $(Ti,Cr)B_2$ + 50% W_2B_5. It is shown that the modulus of elasticity also increases with increasing hardness, and the wear resistance also increases simultaneously. A definite correlation exists between these parameters. Thus the physical-mechanical properties of cast articles which have a refractory compound as a base are determined by the crystal lattice bond strength which in turn depends on the electronic structure, type of hybridization of electron orbits, and the degree of participation of valence electrons in the chemical bond. (SJR)

24589 MECHANISM OF AGGLOMERATING RECRYSTALLIZATION IN CARBIDES OF GROUP IV AND V TRANSITION METALS. Bozhko, S. A. (Inst. of Problems in Materials Science, Kiev). pp 93-98 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

An investigation was made on the recrystallization kinetics of titanium, zirconium, and niobium carbides in their homogeneity regions. Recrystallization kinetics was investigated by determining the average grain size from the number of reflexes on the full Debye circle after annealing at temperatures of 1500 to 2000°C. Noticeable grain growth starts in titanium carbides (with an initial grain size of ~32 microns) at temperatures of 1500°C ($TiC_{0.82}$) and 1600°C ($TiC_{0.75}$ to $TiC_{0.98}$). In the zirconium carbides (with an initial grain size of ~25 microns) grain growth begins at a temperature of 1750°C, and in the niobium carbides (with an initial grain size of ~10 microns) grain growth begins at a temperature of 1850°C. The activation energy for the agglomeration recrystallization was lowest for the titanium carbides, and increases on going to zirconium carbide, and again on going to niobium carbide. (SJR)

24590 REGIONS OF HOMOGENEITY OF THE CUBIC OXYCARBIDES OF ZIRCONIUM AND HAFNIUM AND THE CONCENTRATION DEPENDENCE OF THE DEGREE OF FILLING OF THEIR ELEMENTARY CELLS. Zainulin, Yu. G.; Alyamovskii, S. I.; Shveikin, G. P.; Gel'd, P. V. (Inst. of Chemistry, Sverdlovsk, USSR). pp 105-112 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

Zirconium and hafnium oxycarbides having the general formula MeC_xO_y were synthesized by vacuum sintering of briquetted mixtures of the components at temperatures of 1700°C for the zirconium oxycarbides and 1900°C for the hafnium oxycarbides. The chemical composition, pycnometric density, lattice constants, and number of particles in the elementary cell are tabulated for 23 single-phase cubic oxycarbides of zirconium and 13 single-phase cubic oxycarbides of hafnium. The lattice periods of ZrC_xO_y and HfC_xO_y increase with increasing content of oxygen and carbon respectively at constant values of x and y, and also on replacement of oxygen atoms by carbon atoms at $x + y$ = constant. (SJR)

24591 STUDY OF THE CONDITIONS OF PRODUCING DODECABORIDES OF METALS AND THEIR ELECTROPHYSICAL PROPERTIES. Paderno, Yu. B.; Odintsov, V. V. (Inst. of Problems in Materials Science, Kiev). pp 112-119 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

Dodecaborides of yttrium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, and zirconium were prepared by reducing the metal oxides with boron in crucibles of zirconium diboride under vacuum at temperatures of 1450 to 1600°C. A boron excess of 4 to 6% is necessary to obtain borides of stoichiometric composition. X-ray and metallographic analyses showed that single-phase material was produced. The following properties were investigated: electrical resistance and thermal emf in the temperature interval from 20 to 900°C, microhardness at room temperature, thermal expansion coefficient in the temperature interval from −195 to 1000°C, the Hall coefficient, and the thermal conductivity at 20°C. (SJR)

24592 TETRAHEDRAL MODEL OF THE ELECTRON CONFIGURATION OF ATOMS IN CARBIDES OF GROUP IV METALS. Kolotilo, D. M. (Inst. of Problems in Casting, Kiev). pp 126-128 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

It has been shown that the length of binding sp^3 orbitals does not change on changing the interatomic distance. Hence an attempt is made by using compounds with known interatomic distances to estimate the length of the binding sd orbitals of the metals and to construct a tetrahedral model of the carbides. On constructing a crystal lattice model of the corresponding carbides by starting from the tetrahedral, hydrid, electron sd^3 configuration of the metal and the sp^3 configuration of carbon, a value of 4.52 Å is obtained for the "a" lattice constant of TiC, and a value of 4.88 Å is obtained for ZrC. The experimental values are 4.32 and 4.698 Å for TiC and ZrC respectively. The calculated values are 6 and 4% greater respectively than the values determined experimentally. (SJR)

24593 WORK FUNCTION OF THE BORID PHASES OF NIOBIUM AND CHROMIUM. Samsonov, G. V.; Fomenko, V. S.; Kunitskii, Yu. A. (Inst. of Problems in Materials Science, Kiev). pp 142-147 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. A. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

The samples were prepared by hot pressing the boride powders obtained by reducing the metal oxide with boron in vacuum. The work function was determined by measuring the full current with an accuracy of 2 to 3% with the Schottky effect being taken into account. The work function given in eV units increases linearly with temperature as follows: $3.35 + 1.4 \times 10^{-4}$ T for Nb_3B_2; $3.58 + 1 \times 10^{-4}$ T for NbB; $3.88 + 8 \times 10^{-5}$ T for Nb_3B4; $4.03 + 1.6 \times 10^{-4}$ T for NbB_2; $2.46 + 4 \times 10^{-4}$ T for Cr_4B; $2.72 + 3.0 \times 10^{-4}$ T for Cr_2B_2; $3.02 + 4.6 \times 10^{-5}$ T for CrB; $3.12 + 8.0 \times 10^{-5}$ T for Cr_3B_4, and $3.18 + 1.0 \times 10^{-4}$ T for CrB_2 over the temperature interval from 1300 to 2100°K. (SJR)

24594 THERMOEMISSION PROPERTIES OF GROUP IV AND V TRANSITION METAL CARBIDES IN THE HOMOGENEITY REGIONS. Samsonov, G. V.; Naumenko, V. Ya.; Okhremchuk, L. N.; Podchernyaeva, I. A.; Fomenko, V. S. (Inst. of Problems in Materials Science, Kiev). pp 147-156 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. A.; (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

Carbide powders prepared by the direct synthesis of metal and carbon in an electrical vacuum furnace were densified by hot pressing to give samples having a porosity of 6 to 10%. The work function was determined by the full current method in vacuum with electron heating of the samples. The work function in electron volts is given by the following analytical expressions over the temperature interval from 1500 to 2100°K (values of the work function at 1800°K in eV are given in parenthesis): $4.38 - 1 \times 10^{-4}$ T (4.20) for $TiC_{0.96}$; $4.37 - 1.6 \times 10^{-4}$ T (4.08) for $TiC_{0.88}$; $4.28 - 2.0 \times 10^{-4}$ T (3.92) for $TiC_{0.83}$; $4.15 - 2.5 \times 10^{-4}$ T (3.75) for $TiC_{0.79}$; $4.05 - 2.5 \times 10^{-4}$ T (3.65) for $TiC_{0.73}$; $4.52 - 2.8 \times 10^{-4}$ T (4.02) for $ZrC_{0.97}$; $5.1 - 6.0 \times 10^{-4}$ T (4.00) for $ZrC_{0.9}$; $5.17 - 6.7 \times 10^{-4}$ T (3.97) for $ZrC_{0.8}$; $5.10 - 6.6 \times 10^{-4}$ T (3.91) for $ZrC_{0.75}$; $5.10 - 6.8 \times 10^{-4}$ T (3.88) for $ZrC_{0.7}$; $3.05 + 5 \times 10^{-4}$ T (3.95) for $HfC_{0.98}$; $3.0 + 5 \times 10^{-4}$ T (3.90) for $HfC_{0.9}$; $2.75 + 6 \times 10^{-4}$ T (3.83) for $HfC_{0.8}$; $2.63 + 6 \times 10^{-4}$ T (3.71) for $HfC_{0.71}$; $2.52 + 6 \times 10^{-4}$ T (3.60) for $HfC_{0.63}$; $d\phi/dt = 0$ (4.07) for $VC_{0.87}$; $d\phi/dt = 0$ (4.04) for $VC_{0.83}$; $d\phi/dt = 0$ (4.03) for $VC_{0.77}$; $d\phi/dt = 0$ (3.99) for $VC_{0.73}$; $4.25 - 1.9 \times 10^{-4}$ T (3.93) for $NbC_{0.99}$; $4.39 - 1.8 \times 10^{-4}$ T (4.05) for $NbC_{0.88}$; $4.45 - 1.7 \times 10^{-4}$ T (4.14) for $NbC_{0.83}$; $4.18 - 2 \times 10^{-4}$ T (3.82) for $TaC_{0.93}$; $4.46 - 2.5 \times 10^{-4}$ T (4.01) for $TaC_{0.88}$; $4.17 - 1.8 \times 10^{-4}$ T (3.85) for $TaC_{0.73}$. (SJR)

24595 THERMOEMISSION PROPERTIES OF THE MIXED CARBIDE TiC–WC IN THE HOMOGENEITY REGION. Podchernyaeva, I. A.; Siman, N. I.; Fomenko, V. S.; Chaplygin, F. I. (Inst. of Problems in Materials Science, Kiev). pp 156-160 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. A.; (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

The work function was measured on a series of mixed TiC-WC carbides. It was found that the work function (in eV units) increases with increasing content of tungsten carbide as a result of an increase in covalent bonding. Values of the work function in ev units are given as a function of temperature T (°K): $3.66 + 2.5 \times 10^{-4}$ T for TiC; $3.86 + 2.0 \times 10^{-4}$ T for 0.7 TiC + 0.3 WC; $3.88 + 2.5 \times 10^{-4}$ T for 0.6 TiC + 0.4 WC; $3.82 + 2 \times 10^{-4}$ T for 0.5 TiC + 0.5 WC; $3.81 + 2.4 \times 10^{-4}$ T for 0.4 TiC + 0.6 WC; $3.25 + 4.4 \times 10^{-4}$ T for 0.25 TiC + 0.75 WC. (SJR)

24596 CONNECTION OF AIR-ABRASIVE RESISTANCE OF ZIRCONIUM DIBORIDE AND HARD-METAL ALLOYS WITH THEIR ELECTRONIC STRUCTURE. Dan'kin, A. A. (All Union Scientific-Research Inst. and Projective Chemical Inst. of Mechanical Engineering, Moscow). pp 160-164 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. A.; (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian)

Samples $40 \times 25 \times 5$ mm were subjected to attack by impingement of a jet stream of abrasive. The two-phase flow velocity was 507 m/sec, and the mass flow of abrasive was 45.7 g/cm²-sec. For zirconium diboride the wear rates in cm³/kg after 30 seconds of attack were 0.0166 at a 30° angle of attack, 0.030 at a 60° angle, and 0.0219 at a 90° angle of attack. Wear was a maximum at a 60° angle of attack. ZrB_2 wear resistance is a factor of about 10 better than the wear resistance of Cr 18–Ni 10 stainless steel. The wear resistances of TiC and WC cemented in cobalt were determined as a function of WC and cobalt content. The relation of wear resistance to electronic structure is discussed. (SJR)

24597 TRANSMISSION ELECTRON MICROSCOPY OF PROPENE-DERIVED PYROLYTIC CARBON COATINGS. Yust, C. S.; Krautwasser, H. P. (Kernforschungsanlage, Juelich, Ger.). Carbon; 13: No. 2, 125-133(Apr 1975).

The microstructures of a series of pyrocarbon coatings prepared from a 20% propene atmosphere in the temperature range 1250 to 2000°C were examined by transmission electron microscopy. The structures vary markedly with temperature, and the structural changes can be correlated with density and microporosity measurements. At temperatures between 1400 and 2000°C, the structure can be described in terms of two components; the relative amount of each component is dependent on the temperature. (auth)

24598 LOW-TEMPERATURE PHASE CONVERSION IN THE Zr–H SYSTEM. Naskidashvili, I. A.; Topchyan, L. S.; Melik-Shakhnazarov, V. A.; Andrievskii, R. A.; Savin, V. I.; Bydlinskaya, I. N.; Krizhak, D. S. pp 123-138 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

Studies of the Zr–H system by calorimetric and internal friction methods showed anomalies in the temperature dependence of the heat capacity from 160 to 200°K. From 100 to 250°K, there were attenuation maxima and anomalies of the modulus of elasticity. The data indicate that in δ–Zr–H there are two phase conversions of H. Heat capacity anomalies increased with decreasing H/Zr, and at H/Zr = 2 there was no phase transition. Increasing the H/Zr ratio shifted the transition to lower temperatures, and at low temperatures δ-Zr changed to δ'- and δ''-Zr. At about 300°K internal friction was maximum owing to H diffusion hydrogen diffusion. (TTT)

24599 LOW-TEMPERATURE ANOMALIES OF THE COEFFICIENT OF EXPANSION IN THE Zr–H SYSTEM. Naskidashvili, I. A.; Topchyan, L. S.; Chachanidze, R. V. pp 139-143 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

Low-temperature-dilatometer measurements showed that thermal expansion in the Zr–H system changes anomalously in the temperature range 150–210°K. The change depends on the hydrogen concentration in the zirconium, on the number of cooling cycles to which the samples have been subjected, and on the cooling rate. The large change in the thermal expansion coefficient at low temperatures is related to phase conversions in the hydrogen sublattice. (TTT)

24600 EFFECT OF LOW-TEMPERATURE REACTOR IRRADIATION ON THE Zr–H SYSTEM. Naskidashvili, I. A.; Topchyan, L. S.; Melik-Shakhnazarov, V. A.; Andrievskii, R. A.; Savin, V. I.; Krizak, D. S.; Petrosyan, V. V.; Bydlinskaya, I. N. pp 186-196 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

Calorimetric measurements showed that for $ZrH_{1.65}$ there are three heat-release peaks on the annealing curve for irradiated samples, while for $ZrH_{1.85}$ and $ZrH_{1.95}$ there are only two in the temperature interval 155-200°K. Two peaks appear to be typical for the ε phase and three for the δ. As the stoichiometric composition ZrH_2 is approached, the heat release in the first peak decreases. Possibly there are local changes in hydrogen concentration so that a single-phase sample, after irradiation, may contain inclusions of different phases. This can occur only when the irradiation temperature is below the first low-temperature phase conversion. An increase in the electrical resistance of irradiated hydrides indicates that the increase in electrical resistance when annealing is done in the temperature interval studied depends on the H/Zr ratio. An increase in this ratio results in a decrease in the fraction of annealed centers of electron dispersions. (TTT)

24601 EFFECT OF SHOCK COMPRESSION ON CRYSTAL STRUCTURE OF BORON NITRIDE. Kurdyumov, A. V.; Frantsevich, I. N. (Inst. of Problems in Materials Science, Kiev). Dokl. Akad. Nauk SSSR; 221: No. 3, 588-589(21 Mar 1975). (In Russian).

The results of determining the parameters of the boron nitride (graphite-type) substructure after shock compression, obtained by harmonic analysis of the shape of the hk0 and 00l lines, show that such compression causes a microdeformation of the lattice and crushing of the field of coherent dispersion in both directions, with a more significant effect in the direction of the c axis owing to the less stable bond between the layers than within the layers. The process of defect formation is especially intense at pressures higher than the phase transition pressure for boron nitride from the graphite-like to the Wurtz form. (TTT)

24602 ANNEALING OF RADIATION DEFECTS IN CORUNDUM CRYSTALS. Abdukadyrova, I. Kh.; Vakhidov, Sh. A.; Khaimov-Mal'kov, V. Ya. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 62-65(1975). (In Russian).

Results of experimental studies on the dependence of the temperature of annealing of radiation defects introduced by radiation into corundum crystals at 40 to 1100°C are presented. Basic annealing stages for absorption bands in the visible and near-uv spectrum regions are shown. (tr-auth)

24603 CHEMICAL VAPOR DEPOSITION OF ISOTROPIC CARBON–ZIRCONIUM CARBIDE FUEL PARTICLE COATINGS. Reynolds, G. H.; Kaae, J. L. (General Atomic Co., San Diego, Calif. (USA)). J. Nucl. Mater.; 56: No. 2, 239-242(May 1975).

The process used to deposit coatings on fuel particles currently under test and evaluation, is described. Codeposition of pyrolytic carbon and a fission product retentive carbide such as zirconium carbide represents a considerable simplification of the fuel particle manufacturing process. (auth)

24604 PHASES AND PHASE TRANSITIONS AT HIGH TEMPERATURE OBSERVED IN THE $ThO_2-Ln_2O_3$(Ln = LANTHANIDE AND YTTRIUM)SYSTEMS. Sibieude, F.; Foex, M. (Laboratoire des Ultra-Refractaires (CNRS), BP No. 5 Odeillo, 66120 Font Romeu, France). J. Nucl. Mater.; 56: No. 2, 229-238(May 1975). (In French).

The various phases and phase transitions in the $ThO_2-Ln_2O_3$ systems (Ln = lanthanide and yttrium) were determined from ambient temperature up to the melting point, by means of methods permitting examination of the samples "in situ" at high temperature. The results obtained have prompted a hypothesis concerning the phase diagrams of these binary systems. (auth)

24605 PHASE RELATION AND DEFECT STRUCTURES OF NONSTOICHIOMETRIC U_4O_{9+y} AND UO_{2+x} AT HIGH TEMPERATURES. Matsui, T.; Naito, K. (Nagoya Univ. (Japan). Faculty of Engineering). J. Nucl. Mater.; 56: No. 3, 327-335(Jun 1975).

Phase relations in the composition range from UO_{2+x} to U_3O_{8-z} were studied by electric conductivity measurements and x-ray diffraction in the ranges 1025°C ≤ T ≤ 1140°C and 10^{-7} atm ≤ $P_{O_2} \leq 10^{-3}$ atm. The plot of log σ versus log P_{O_2} showed straight lines with distinct slopes, which corresponded to four regions (UO_{2+x}, U_4O_{9-y}, U_4O_{9+y} and U_3O_{8-z}). The existence of the hyperstoichiometric U_4O_{9+y} phase was suggested in the temperature range from 1025 to 1126°C. The peritectoid temperature ($U_4O_{9\pm y}$ = UO_{2+x} + U_3O_{8-z}) estimated to be present between 1126 and 1131°C. The partial free enthalpies and entropies for the two-phase equilibrium (U_4O_{9+y} + U_3O_{8-z}, and U_4O_{9-y} + UO_{2+x}) were calculated and compared with previous results. From the dependence of the electrical conductivity on the oxygen partial pressure the nonstoichiometric defect structures of UO_{2+x} and U_4O_{9+y} were interpreted as consisting of doubly charged oxygen interstitials (O_i'') and doubly charged oxygen vacancies (V_O''). At room temperature, the homogeneity range of the U_4O_9 phase was investigated with a Debye-Scherrer camera. (auth)

24606 INVESTIGATIONS ON URANIUM CARBONITRIDES. I. The Lattice Parameters of the Solid Solutions. Cordfunke, E. H. P. (Stichting Reactor Centrum Nederland, Petten). J. Nucl. Mater.; 56: No. 3, 319-326(Jun 1975).

The lattice parameters of the UC-UN solid solutions were measured at room temperature as a function of composition. Equilibrium was approached from two directions, by starting from UC + UN or from UN + graphite mixtures. After equilibrium, which was readily obtained at 1800°C, a careful chemical characterization was carried out, including chemical analyses of all major elements. (auth)

24607 ELECTRICAL RESISTIVITY OF URANIUM MONOSULFIDE FROM ROOM TEMPERATURE TO 1500°C. Matsui, H.; Kirihara, T. (Nagoya Univ. (Japan). Faculty of Engineering); Nasu, S. (Japan Atomic Energy Research Institute, Tokai-mura, Ibaraki-ken, 319-11 Japan). J. Nucl. Mater.; 56: No. 3, 362-364(Jun 1975).

Measurements of the electrical resistivity of US were made in the temperature range from room temperature to 1500°C using specimens cut from the same pellet for which the thermal diffusivities were measured. The results were compared with those estimated from the data of the thermal properties. (auth)

24608 TWINNING OF $UReC_{2-x}$. Alexeyeva, Z. M. (AN SSSR, Moscow. Inst. Metallurgii). J. Nucl. Mater.; 56: No. 3, 359-361(Jun 1975).

Extra reflections have been observed on x-ray diffraction patterns of $UReC_{2-x}$. These reflections are positioned both on nodes and in interstices of the reciprocal lattice indicating twinned crystals. (UK)

24609 CONTRIBUTION TO THE ESTABLISHMENT OF THE PHASE DIAGRAM OF THE U-C-O SYSTEM WITH THE AID OF X-RAY DIFFRACTOMETRY AT HIGH TEMPERATURE UNDER KNOWN PRESSURE. Plaloux, A.; Dode, M. (Paris-11 Univ., 91- Orsay (France). Lab. de Chimie Thermodynamique). J. Nucl. Mater.; 56: No. 2, 221-228(May 1975). (In French).

During the progressive reduction of uranium dioxide by graphite under known pressures of carbon monoxide, the lattice parameters of the compounds "UO_2" (fcc), α-"UC_2" (tetragonal) and "UC" (fcc) have been measured, and the compositions of these nonstoichiometric phases near 1770°C have been evaluated. By this means, and for the first time thanks to these direct measurements at such high temperatures, it has been possible to establish with precision the range of the main univariant phase fields ["UO_2," C, α-"UC_2," CO] and ["UO_2," α-"UC_2," "UC," CO]. The part of the U-C-O diagram thus mapped out completes the earlier isotherm for 1700°C determined by Henry et al. (auth)

24610 MICROSTRUCTURE OF VAPOR-DEPOSITED ZrC-C ALLOY. Fukuda, K.; Ikawa, K.; Kobayashi, F.; Iwamoto, K. (Division of Nuclear Fuel Research, Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan). J. Nucl. Mater.; 56: No. 2, 243-245(May 1975).

Vapor-deposited zirconium carbide-carbon alloy (CVD zirconium Carballoy) is an interesting material as an improved coating of HTGR fuel particles. The microstructure of the zirconium-carbon alloy prepared by the reaction-sintering method was investigated. Properties of CVD zirconium Carballoy, however, are not known well. In the present study, the microstructure of the CVD Carballoy coating prepared by the bromide process was observed by a scanning electron microscope (SEM). (auth)

24611 DETERMINATION OF THE COMPLEX REFRACTIVE INDEX PROFILES IN P_{31}^+ ION IMPLANTED SILICON BY ELLIPSOMETRY. Adams, J. R.; Bashara, N. M. (Nebraska Univ., Lincoln (USA)). Surf. Sci.; 49: No. 2, 441-458(Apr 1975).

Ellipsometry was used to determine the complex refractive index profiles in silicon implanted with P_{31}^+ ions with energies of 35, 52, 5, and 70 keV. The profiles were determined both by anodization-stripping of the implanted layer and by numerical fitting of multiple-angle-of-incidence ellipsometer data taken on the as-implanted surface, assuming that the implantation would exhibit a Gaussian distribution. Good correlation was obtained between the two types of profiles, indicating that the nondestructive measurements on the as-implanted surface may be useful in process control. Good agreement with published results was also obtained on the increase in depth with energy of both the damage and the implanted species. (auth)

24612 REDETERMINATION OF THE CARBON-RICH PHASE BOUNDARY ON URANIUM MONOCARBIDE. Scherff, H. L.; Springer, A. (Euratom, CCR Ispra, Italy). J. Nucl. Mater.; 56: No. 2, 153-160(May 1975).

The phase boundary between UC_{1+X} and βUC_2 in the temperature range of 1900 to 2100°C and for C/U ranging from the stoichiometric up to the congruently vaporizing composition (1.00-1.08) was redetermined. Samples containing originally 4.75 to 4.80 wt % C were heated at constant temperatures under vacuum in a high-temperature thermobalance. Due to preferential vaporization of U the C/U ratio continuously increased under these conditions until precipitation of the second phase took place which could be deduced from the continuously recorded weight-change curves. The respective equilibrium phase boundary thus derived is markedly different from that obtained by earlier investigators on the basis of quenching experiments. Precipitation of βUC_2 occurs at much lower C/U ratios than assumed up to now. (auth)

24613 NEUTRON DAMAGE AND FISSION PRODUCT GAS RELEASE IN THE INITIAL BURST REGION OF URANIUM MONOCARBIDES. Matsui, H. (Nagoya Univ. (Japan). Faculty of Engineering). J. Nucl. Mater.; 56: No. 2, 161-168(May 1975).

Thermal neutron damage and fission product gas (^{133}Xe) release in a burst region of uranium monocarbides were studied. After neutron irradiation, the electrical resistivity was measured from room temperature to 800°C. Three recovery stages were revealed in the resistivity of UC irradiated to 4.0×10^{16}nvt. The lattice parameter of UC with the same irradiation also showed three stages of recovery up to 1050°C. The initial burst of Xe from UC was studied in a dose range between 1.6×10^{15} and 2.9×10^{18} nvt. The burst occurred in three steps for lightly irradiated specimens, while there were two steps of the burst in heavily irradiated specimens. The activation energies for each burst step were calculated. From the results obtained, it was concluded that the burst was correlated with the recovery of damage in the neutron-irradiated UC. (auth)

24614 NEUTRON IRRADIATION EFFECTS IN URANIUM DICARBIDES. Matsui, H.; Takada, T.; Kirihara, T. (Nagoya Univ. (Japan). Faculty of Engineering); Nasu, S. (Japan Atomic Energy Research Institute, Tokai-mura, Ibaraki-ken, Japan). J. Nucl. Mater.; 56: No. 3, 275-278(Jun 1975).

Changes of electrical resistivity and lattice parameter in $UC_{1.96}$ after neutron irradiation from 9×10^{14} to 2×10^{18}nvt were studied. The resistivity was increased with the dose up to 1×10^{17}nvt, and saturated at that dose. Above 10^{18}nvt a steep increase was observed. In the lattice-parameter changes, on the other hand, a gradual increase was observed in the dose range between 2×10^{16} and 8×10^{17}nvt; above that dose, an abrupt increase followed. Annealing experiments on the resistivity were performed up to 1000°C using the specimens irradiated to the low dose of 5×10^{16}nvt, and the increased resistivity was completely recovered in three steps. The activation energies of each step were estimated to be 0.3, 0.5, and 1.6 ± 0.2 eV. (auth)

24615 OBSERVATIONS ON THE LOW-TEMPERATURE CREEP PROPERTIES OF URANIUM CARBIDE UNDER IRRADIATION. Clough, D. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). J. Nucl. Mater.; 56: No. 3, 279-286(Jun 1975).

The creep behavior of 97% dense hyperstoichiometric UC has been examined during irradiation in three-point bend tests carried out at 450°C up to a dose of 1.65×10^{26} fission/m^3. A rapid decrease in measured strain rate with dose was observed at each stress level, nominally steady-state creep being established above ~1×10^{26} fissions/m^3 when the creep rate was a factor of 8 lower than that observed in UO_2 irradiated under identical conditions. Creep rates were found to be directly proportional to stress at high doses. Comparison of results from this test with data from other experiments up to 2×10^{25} fissions/m^3 in compression and tension indicates little variation in the radiation-creep constant between 450 and 800°C. The creep rate for UC, much lower than that observed in UO_2, is consistent with recently reported determinations of the effective uranium self-diffusion coefficients under irradiation in those materials. (auth)

24616 IRRADIATION SWELLING IN UO_2-SiO_2 FUEL UNDER LOW AXIAL STRESS. Lungu, S. (Institutul de Fizica Atomica, Bucharest (Romania)). J. Nucl. Mater.; 56: No. 3, 307-313 (Jun 1975).

Samples of UO_2-SiO_2 nuclear fuel were irradiated in special capsules, developed for the recording of length changes by very low axial stress (1 kgf/cm^2) without any radial restriction. The results of irradiations at temperatures between 200 and 1300°C and burnups up to 20,000 MWd/t are presented. The experimental results emphasize a long-term compaction which is an irradiation-induced creep, and an important swelling occurring at higher burnups for lower temperatures. Between 1100 and 1200°C and at 1 atm this swelling appears at about 10,000 MWd/t. (auth)

24617 SYNTHESIS OF SINGLE CRYSTALS OF IRON-YTTRIUM GARNET FROM A $PbO-PbF_2-B_2O_3$ SOLUTION. Stel'mashenko, M. A.; Lavrova, S. I.; Agartanova, E. N.; Ginsar, V. E.; Kochetkova, A. V. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 128-130(1975). (In Russian).

The purpose of this study was to find a temperature regime suitable for synthesizing iron-yttrium garnet crystals of high quality by spontaneous crystallization under static conditions. A high yield of crystals with a minimum content of Fe^{2+} ions was desired. The composition of the initial mixture was the following: 11.03 wt % Y_2O_3, 15.65% Fe_2O_3, 39.3% PbO, 32.15% PbF_2, 1.82% B_2O_3 and 0.05 wt % CaO. The temperature was automatically controlled to 0.1°C. A total of 1000 grams of charge was loaded into a platinum crucible 300 ml in volume. The temperature was held at 1200°C for 4 days to decrease the number of initial nuclei. Then the temperature was dropped to 1130°C, and held another 4 days. A total of 108 grams of single crystals of iron-yttrium garnet was obtained, which is 58% of the calculated weight of crystals on the assumption that all the yttrium oxide is used. The evaporation losses were 7.8 wt %. A total of 40 grams of magnetic plumbite $PbFe_{12}O_{19}$ was obtained with a platelet size of 3 to 4 mm. The main mass of crystals $Y_3Fe_5O_{12}$ was 5 to 15 mm in size. The crystal density was 5.17 to 5.18 g/cm^3, which agrees well with the x ray density. The surface density of dislocations determined by etching with phosphoric acid was 10^3 cm^{-2}. The content of Fe^{2+} ions in the crystals was 0.05 wt %. The crystals were of high quality. (tr-SJR)

24618 STUDY BY THE ESR METHOD OF THE ADSORPTION OF CARBON MONOXIDE ON ALUMINUM OXIDE UNDER THE ACTION OF GAMMA RADIATION. Shirikov, N. G.; Sazonov, L. A. (Inst. of Crystals, Novosibirsk, USSR). Kinet. Catal.; 15: No. 6, 1387-1392(1974).

Translated from Kinet. Katal.; 15: No. 6, 1572-1579(1974).

The forms of interaction of CO with the surface of Al_2O_3 were studied using the ESR method and irradiating with γ rays. Seven paramagnetic formations, the ratio among which depends on the conditions of adsorption of CO, irradiation, and preliminary treatment of the Al_2O_3, were found. Radiation adsorption occurs chiefly on account of an interaction of CO with the p-type center O^- with the formation of CO_2^- and $C_2O_3^-$. On nonirradiated Al_2O_3, aluminum and oxygen ions participate in the adsorption of CO. It is suggested that the σ-complex formed in the adsorption of CO on Al^{3+}, as a result of subsequent irradiation, captures an electron with the formation of a supplementary π-bond. The adsorption of CO shows that the irradiation of Al_2O_3 leads to a reduction of impurity iron ions. (auth)

Metals and Alloys

Refer also to abstract 25265.

24619 (RDT-M-3-16T(8-75)) CARBON AND ALLOY STEEL PIPE (ASME SA-333 WITH ADDITIONAL REQUIREMENTS.) (Atomic Energy Commission Combined Operations Planning, Oak Ridge, Tenn. (USA)). Aug 1975. 7p. RSO.

This standard covers carbon and alloy steel pipe for nuclear and associated applications. The additional requirements include analysis, testing, examination, Charpy V-notch, etc. (DLC)

24620 (RDT-M-3-18T(8-75)) NICKEL-MOLYBDENUM-CHROMIUM ALLOY SEAMLESS TUBES. (ASME SB-163 With Additional Requirements). (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Research and Development). Aug 1975. RSO.

This standard covers Ni-Mo-Cr alloy seamless tubes for nuclear and associated applications. The additional requirements and optional provisions include testing, examination, etc. (DLC)

24621 (RDT-M-4-1T(8-75)) CARBON STEEL CASTINGS, (ASME SA-216 WITH ADDITIONAL REQUIREMENTS). (Atomic Energy Commission Combined Operations Planning, Oak Ridge, Tenn. (USA)). Aug 1975. RSO.

This standard covers carbon steel castings for nuclear and associated applications. The additional requirements cover composition, fracture toughness, Charpy V-notch, dropweight tests, liquid penetrant examination, etc. (DLC)

Corrosion and Erosion

Refer also to abstracts 24714, 25250, and 25277.

24622 (AEC-tr-7314, pp 197-201) CHOICE OF PROTECTIVE COATINGS IN THE WORKING ZONE OF THE REACTOR FOR CARRYING OUT THE RADIOCHEMICAL SYNTHESIS OF METHYLPHENYLDICHLOROSILANE. Osipov, V. B.; Mamin, E. B.; Kon'kov, N. G.; Drachev, B. V.; Korneeva, G. P.; Krutetskaya, O. N. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Protective coatings for steel vessels used to contain radio-induced synthesis of methylphenyldichlorosilane (MPDSC) were evaluated. It was found that molybdenum glass is the best liner, but difficult to emplace, and gold second best. An inert hydrolyzed film of MPDSC forms on the gold liners lowering the MPDSC synthesis yield. This film can be removed from the gold by application of alkali washes followed by drying and degassing. (JRD)

24623 (AECL-5110) HYDRIDE ORIENTATION IN Zr-2.5% Nb; HOW IT IS AFFECTED BY STRESS, TEMPERATURE, AND HEAT TREATMENT. Bell, L. G.; Duncan, R. G. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jun 1975. 25p. Dep. NTIS (US Sales Only) $4.25. AECL $1.00.

Transverse uniaxial specimens of cold-worked and of heat-treated Zr-2.5%Nb pressure tubing were hydrided and subjected to stress during cooling. Measurements showed that stress-induced hydride orientation is more pronounced when the temperature of initial precipitation is increased. At temperatures below 430°C, there is a threshold stress in cold-worked Zr-2.5%Nb below which there is effectively no change in hydride orientation. When initial precipitation takes place at 360°C, the threshold stress is 100 MPa but it decreases with temperature and becomes zero at about 430°C. One test in which hydrides were not completely dissolved showed that hydride stress orientation is influenced by the residual hydrides. An 880°C intermediate-cool heat treatment produced material with relatively poor initial hydride morphology from the point of view of pressure tube integrity, and stress caused further deterioration. Comparison with results on cold-worked Zr-2.5% Nb indicated that crystallographic texture has little influence on hydride orientation. (auth)

24624 (ICP-1053) CORROSION OF HIGH NICKEL ALLOYS IN COMBINED FLUORIDE SOLUTIONS FOR NUCLEAR FUEL REPROCESSING. Paige, B. E.; DePue, N. A. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Jul 1975. Contract E(10-1)-1375. 69p. Dep. NTIS $5.45.

The chemical reprocessing of fuel from the Pressurized Water Reactor (PWR) Core 2, Seed 1 and 2, requires hydrofluoric acid, nitric acid, and sulfuric acid singly and in mixtures. High nickel alloys tested in scoping tests at the boiling point in PWR process solutions included Hastelloy C-276, Hastelloy C-4, Hastelloy S, Hastelloy G, Inconel 625, Inconel 690 and Incoloy 825. Evaluations of weld performance including some metallographic examinations are included. Different methods of welding and different heats of alloys were investigated. The effect of varying compositions and concentration of process solutions were examined in order to select conditions which would minimize corrosion. Corrosion results are also presented for two Hastelloy C276 corrosion test vessels fabricated from 3-inch welded pipe with welded nozzles. These vessels have been exposed to PWR process solution for several months. They have provided valuable information on the

performance of welds, the attack at the vapor-liquid interface, and the mode of attack to be expected in process service. (auth)

24625 (SAND-75-5159) RELATIONSHIP BETWEEN THERMAL EMBRITTLEMENT AND HYDROGEN CRACKING IN 18Ni(250) MARAGING STEEL. Rack, H. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 12p. (CONF-750925-5). Dep. NTIS $4.00.

From conference on effects of hydrogen on behavior of materials; Jackson, Wyoming, USA (7 Sep 1975).

The role of grain boundary precipitate structure on the stress corrosion susceptibility of 18Ni(250) maraging steel was examined. Varying solution treatment procedures were used to achieve either a precipitate-free grain boundary or one containing a high density of Ti(C,N) particles. The introduction of these treatments, although drastically affecting the monotonic fracture toughness, did not significantly alter the stress corrosion threshold in 100 percent relative humidity. These results are shown to be consistent with the previous suggestion that, under open circuit conditions, hydrogen-assisted cracking controls the environmental crack growth behavior of 18Ni maraging steels. (auth)

24626 (SAND-75-5710) CRACKING OF U–0.75 WT. PERCENT Ti IN HYDROGEN AND WATER VAPOR. Magnani, N. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 16p. (CONF-750925-1). Dep. NTIS $4.00.

From conference on effects of hydrogen on behavior of materials; Jackson, Wyoming, USA (7 Sep 1975).

The data obtained in this investigation have shown that the crack velocity of U–0.75 wt percent Ti in H_2 has a linear dependence on time, an exponential dependence on temperature, a power dependence on pressure, and increases as the strength of the material increases. The H_2 cracking data also exhibited an anomalous behavior wherein cracking occurred in the absence of an applied load. This is attributed to corrosion product wedging. UH_3 has a density of 11 g/cm^3 while the U–Ti alloy has a density of 18.5 g/cm^3. This corresponds to an increase in volume of 70 percent when the hydride is formed. It is felt that the reaction of the fracture surface with the H_2 environment leads to the formation of copious amounts of hydride which interferes with the relaxation of the crack opening as the stress intensity is lowered. (auth)

24627 ELECTROCHEMICAL STUDY OF UNDERCUTTING DURING ETCHING OF DUPLEX METAL FILMS. Kelly, J. J.; de Minjer, C. H. (Phillips Research Labs., Eindhoven, Netherlands). J. Electrochem. Soc.; 122: No. 7, 931-936(Jul 1975).

For various technological applications, patterns are chemically etched in metal films partly covered with a nobler metal. As a result of the bimetallic contact, accelerated etching may occur, giving rise to considerable undercutting. From electrochemical considerations it was expected that the use of certain chemical polishing solutions would significantly reduce the degree of such undercutting. This was verified by studying the electrochemical properties of various polishing and nonpolishing etching agents. Suitable solutions were developed for the etching of Al, Mo, and Ni-P. These etching agents, when used to etch metal films partly covered by nobler metals, gave markedly less undercutting than nonpolishing etching agents. (auth)

24628 EFFECT OF IRRADIATION AND ANNEALING IN THE ELASTIC STRESSES STATE ON THE BUASCHINGER EFFECT IN POLYCRYSTALLINE Ti. Gindin, I. A.; Lapiashvili, E. S.; Naskidashvili, I. A.; Neklyudov, I. M.; Novozhilov, V. L. pp 68-76 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

Neutron irradiation of cylindrical polycrystalline Ti samples increased the viscosity of the metal and decreased the relative length of the samples. Subsequent annealing under even load conditions increased the viscosity further. These effects were accompanied by an increase in stress at the beginning of the appearance of the Bauschinger effect and a change in the nature of its dependence on the increase in applied load. With further increase in the deformation, the rate of increase in the Buaschinger effect increased. With nonhomogeneous distribution of tension in the loaded samples, internal forces arise and cause gradual transfer of the elastic deformation to microplasticity and relaxation of the internal stress. (TTT)

24629 CARBON EXCHANGE BETWEEN STABILIZED AUSTENITIC STEELS AND LIQUID SODIUM. Schneider, H.; Borgstedt, H. U.; Frees, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). J. Nucl. Mater.; 56: No. 3, 336-340(Jun 1975). (In German).

The carbon-concentration profiles in the surface zones of specimens of stabilized austenitic steels have been measured after exposure to liquid sodium of 700°C in a sodium circuit. Under the conditions of the tests the specimens were carburized. However, the carbon content of the ferritic corrosion layers decreased to values the initial values. They corresponded to the carbon activity of the sodium. (auth)

24630 STUDY OF THE REACTION OF BULK MAGNESIUM WITH AIR. Dupre, B. (Nancy-1 Univ., 54 (France)); Streiff, R. (Aix-Marseille-1 Univ., 13- Marseille (France)). J. Nucl. Mater.; 56: No. 2, 195-207(May 1975). (In French).

The reaction of magnesium with air follows very irregular kinetics; periods of slow and rapid growth alternate in random fashion. It is shown that initially the metal reacts simultaneously with nitrogen and oxygen. A nitride layer is formed next to the metal and an oxide layer next to the gas. This double layer becomes temporarily protective, which leads to a substantial slowing down of the rate of weight increase. Sudden cracking entails a rapid acceleration of both oxydation and nitridation, giving rise to two surface layers. An irregular sequence of several fast and slow stages leads to the development of a sharply layered film. The cracks formed when the oxide layer is thicker are gradually sealed by the products of vapour-phase reactions. The total layer then acquires a distinct protective power, and the gases can no longer reach the metal surface. The reaction then starts again by the oxidation of the strata of nitride formed earlier and proceeds at a slow but regular pace. (auth)

24631 STUDY OF HYDROGEN CHEMISORBED ON RANEY-NICKEL BY NEUTRON INELASTIC SPECTROSCOPY. Stockmeyer, R.; Conrad, H. M. (Kernforschungsanlage Juelich G. m. b. H. (F. R. Germany). Inst. fuer Festkoerperforschung); Renouprez, A.; Fouilloux, P. (Centre National de la Recherche Scientifique, 69- Villeurbanne (France). Inst. de Recherches sur la Catalyse). Surf. Sci.; 49: No. 2, 549-566(Apr 1975).

The motion of chemisorbed hydrogen on the Raney-nickel surface was studied by neutron inelastic spectroscopy. The peaks found at low energy transfers (below 320 cm^{-1}) are nearly identical to the spectrum of lattice frequencies of pure nickel. This means that each hydrogen atom is bound to only one nickel atom. The mean square amplitude of the bound proton was found to exceed that of nickel by 0.04 ± 0.02 A^2. A broad band found at 1120 cm^{-1} (800 cm^{-1} in the case of deuterium) is attributed to motions of hydrogen atoms relative to the nickel surface. An interpretation of this band is given in terms of harmonic approximation. An analysis of the shape of the elastic line has shown that no broadening could be detected. This leads to an upper limit for the diffusion constant of the protons, $D < 5 \times 10^{-7}$ cm^2/s, at room temperature. (auth)

24632 DEGRADATION IN THE BIAXIAL STRESS-TO-FAILURE PROPERTIES OF TYPE 316 STAINLESS STEEL EXPOSED TO CESIUM OXIDES. Ross, F.; Maiya, P. S. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 56: No. 2, 136-144(May 1975).

Tubular specimens of 20 percent cold-worked Type 316 stainless steel were exposed to cesium oxides at 660°C for varying times. Grain-boundary corrosion occurred, and the penetration depths varied from 0 to 250 mu m. After the exposure treatment, the specimens were pressurized with helium to investigate the effect of corrosion on the stress-failure properties of the steel at temperatures between 593 and 760°C. The time to failure for the exposed specimens could be predicted from the unexposed-specimen data by assuming that the effect of grain-boundary corrosion is equivalent to the reduction in the thickness of the tube wall. At all temperatures, a decrease in the average diametral strain rate caused the type of failure to change from rupture to pinhole. The pinhole failure was found to be predominantly associated with intergranular fracture mode and the rupture with transgranular fracture mode. (auth)

Preparation and Fabrication

Refer also to abstract 24577.

24633 (LA-6001-T) USE OF A GENERAL-PURPOSE HEAT-TRANSFER CODE FOR CASTING SIMULATION. Erickson, W. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1975. Contract W-7405-ENG-36. 158p. Dep. NTIS $7.60.

The practical use of numerical techniques in simulating casting solidification dictate that a general purpose heat transfer code be used and that results be obtained in an easy-to-analyze format. Color film plotting routines were developed for use with NASA's CINDA-3G heat transfer code; the combination of which meet the above criteria. The subroutine LQSLTR written for SINDA, the successor to CINDA-3G, was verified by comparing calculated results obtained using LQSLTR with those obtained using the specific heat method for handling the heat of fusion. Excellent agreement existed when similar data was used. When the more restrictive requirement of a 1°F melting range was used, comparable results were obtained. Uranium and lead rod castings were cast

in instrumented graphite molds and the solidification sequence simulated using CINDA-3G. Discrepancies attributed to initial assumptions of instantaneous mold filling, uniform melt temperature, and intimate metal/mold contact were encountered. Further calculations using a model incorporating a gap between the mold and casting showed that the intimate contact assumption could not be used; a three-dimensional model also showed that the thermocouple assemblies used with the platinum-platinum-10 percent rhodium were a significant perturbation to the system. An L-shaped steel casting was simulated and the results compared to those reported in the literature. The experimental data for this casting were reproduced within the accuracy permitted by the thermal conductivity of the sand, thus demonstrating that agreement can be obtained when the mold material does not act as a chill. (auth)

24634 (LA-tr-75-13) VACUUM TIGHT SODIUM RESISTANT COMPOUND BETWEEN ThO_2 CERAMIC AND METAL. Reetz, T. Translated from Silikattechnik; 23: No. 12, 412-416(1972). 19p. Dep. NTIS $4.00.

A method for evaluating the mechanical tensions for metal/ceramic joinings was applied to the selection of metal components for a highly vacuum tight, sodium-resistant metal/ThO_2 ceramic solder joining. The metal component selected was the iron-nickel alloy Dilasil which is joined to the ceramic using a nickel-based solder. The wetting of the ceramic could be carried out using the titanium hydride technique or after the formation of a W-cerium layer on the surface of this ceramic. (auth)

24635 (LA-UR-75-804) PREPARATION OF HIGH T/sub c/ Nb_3Ge SUPERCONDUCTORS BY CHEMICAL VAPOR DEPOSITION. Newkirk, L. R.; Valencia, F. A.; Wallace, T. C. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 10p. (CONF-750921-2). Dep. NTIS $4.00.

From 5th international conference on chemical vapor deposition; London, UK (22 Sep 1975).

Bulk layers of Nb_3Ge were deposited on copper substrates at 900°C by the hydrogen reduction of the chlorides of niobium and germanium with resistive T/sub c/'s as high as 22.5°K and current densities up to 1.8×10^6 amp-cm^{-2} at 13.8°K. A detailed description of the coating process as well as empirical correlations between deposition parameters and T/sub c/ is given. Quantitative chlorination of Nb was found to be possible at T approximately 250°C and for T greater than 900°C extending the range of delivery rates below those obtainable by powder feeding of $NbCl_5$. Coatings in the range of 10 to 60 mu m thick have been produced with a typical deposition efficiency of 50 to 65 percent for mass flow rates of the order of 1 g of salt per minute. The superconducting transition temperature has been correlated with a parameter of the form mole ratio x dilution x Reynolds number 0.22, where mole ratio is defined by moles Nb : moles (Ge + 0) in the gas stream, and dilution by moles gas : moles salt. In addition, the relationship between mole ratio and dilution which determines the phase produced (Nb_3Ge or Nb_3Ge_3) is defined over the region of major interest. Lattice spacings are presented over a range of T/sub c/'s, and microstructure and substrate adherence are discussed. (auth)

24636 (LA-UR-75-1414) SPLAT COOLING OF SOME ACTINIDE ALLOYS. Elliott, R. O.; Giessen, B. C. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 13p. (CONF-750915-10). Dep. NTIS $4.00.

From 5th international conference on plutonium and other actinides; Baden-Baden, F. R. Germany (10 Sep 1975).

Several new metastable actinide alloys were produced by rapidly quenching small specimens from the melt. Among these are: (1) the high temperature bcc phases of Pu (epsilon-phase) and Np (gamma-phase) which have been retained at room temperature by splat cooling alloys with Tl or Ga, (2) eta-Pu(Ga), an ordered cubic phase of the substoichiometric CsCl type; this phase exists under equilibrium conditions at high temperatures over the composition range from about 20 to 40 at. percent Ga; its previously unknown structure was determined from the diffraction patterns of splat-cooled alloys, (3) delta$_1$-Pu(Ga), a tetragonal phase of the beta-Np type containing 12.5 to 20 at. percent Ga and (4) a continuous series of fcc solid solutions across the solubility gap in the Pu-Ce system. Metastable delta-Pu(Tl) and delta-Pu(Ga) solid solutions were produced at 20°C in alloys containing about 25 at. percent or less of Tl or Ga, and a metastable alpha-Np(Ga) solid solution was produced in alloys with less than 10 at. percent Ga. These new actinide alloy phases are reviewed and the anomalous increase in atomic volumes of alpha-Np(Ga), gamma-Np(Ga) and epsilon-Pu(Ga) concentrated solid solutions with increasing Ga content is discussed. (auth)

24637 CURRENT-CARRYING CAPACITIES OF SMALL V_3Ga PANCAKES. Fukuda, S. (National Research Inst. for Metals, Tokyo); Tachikawa, K.; Iwasa, Y. Cryogenics; 13: No. 3, 153-157(Mar 1973).

As an intermediate step leading to the production of V_3Ga tapes long enough for magnets of practical size, V_3Ga tapes ranging in length from 5 to 100 meters were produced by surface diffusion. These were wound into single pancakes and their current-carrying capacities were measured in external magnetic fields up to 180 kOe. Results indicate that it should be possible in the near future to construct V_3Ga magnets capable of generating fields as high as 180 kOe, which exceeds by at least 30 kOe the maximum generated by an Nb_3Sn magnet. (auth)

24638 PURIFICATION OF THE RARE EARTH METALS. II. Solid State Electrotransport Processing of Terbium. Jordan, R. G. (Univ. of Birmingham, Eng.); Jones, D. W.; Hems, V. J. J. Less-Common Met.; 42: No. 1, 101-110(Aug 1975).

Solid-state electrotransport processing was demonstrated as a technique for purifying terbium. The results show that both oxygen and nitrogen migrate rapidly in the same direction as the electron flow. Although hydrogen contamination occurs on contact with air, terbium of better than 99.9 at.% has been prepared from commercially-available starting material. The preparation and characterization of high-quality, single-crystal terbium specimens is also described. (auth)

24639 METHOD FOR ELECTRODEPOSITION OF NICKEL-CHROMIUM ALLOYS AND COATING OF URANIUM. Stromatt, R. W.; Lundquist, J. R. (to U. S. Energy Research and Development Administration). US Patent 3,888,744. C23b5/32; C23b5/50. 10 Jun 1975. Filed date 24 Oct 1974. 6p.

PAT-APPL-517,663.

High-quality electrodeposits of nickel-chromium binary alloys in which the percentage of chromium is controlled can be obtained by the addition of a complexing agent such as ethylenediaminetetraacetic disodium salt to the plating solution. The nickel-chromium alloys were found to provide an excellent hydrogen barrier for the protection of uranium fuel elements. (auth)

24640 EFFECT OF THE PHYSICAL-CHEMICAL INTERACTION OF TITANIUM ON THE WEAR RESISTANCE OF REFRACTORY COMPOUND DURING INTERRUPTED MICROCUTTING AT HIGH CONTACT PRESSURES. Bezykornov, A. I.; Bogomolov, N. I.; Koval'chenko, M. S. (Inst. of Problems in Materials Science, Kiev). pp 128-136 of Elektronnoe Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

In cutting titanium alloys the wear resistance of the abrasive cutting tool is a factor of 30 to 50 greater than in cutting steel. It was found that the carbides of zirconium, tungsten, and hafnium, and the borides of tungsten and aluminum showed the least wear in cutting through titanium. Titanium carbide and the borides of chromium and titanium showed a great deal of wear in cutting through titanium, as determined by examining the cutter under a microscope. Adhesion of the abrasive to the metal being cut is an important factor in wear resistance. (SJR)

24641 TEMPERATURE DEPENDENCE OF THE IONIC COMPONENT OF CATHODE SPUTTERING OF REFRACTORY METALS IN AN OXYGEN ATMOSPHERE. Adylov, A. A.; Veksler, V. I.; Reznik, A. M. (Tashkent State Univ.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 81-83(1975). (In Russian).

Data are presented graphically which show that the dependence of the ionic component curve for a pure surface is qualitatively similar to that for the neutral component of cathode sputtering shown earlier. (tr-auth)

24642 INVESTIGATION OF UAl_x-Al DISPERSION FUELS FOR HIGH-FLUX REACTORS. Nazare, S.; Ondracek, G.; Thuemmler, F. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). J. Nucl. Mater.; 56: No. 3, 251-259(Jun 1975).

Preparation of UAl_x-Al dispersion fuel plates for thermal high-flux reactors is described. The work includes the preparation of UAl_2, UAl_3, and UAl_4 compounds by induction melting and their processing to Al-clad fuel plates using the picture-frame technique. Induction melting in alumina crucibles and subsequent homogenization can be used to produce relatively homogeneous UAl_x compounds. After comminution to a predetermined size range and blending with Al, the pressed compacts can be rolled into Al-clad fuel plates. UAl_3 and UAl_2 compounds react with Al forming UAl_4. The reactions begin at about 673°K, and have an activation energy of 52.6 and 42.6 kcal/mol, respectively. The measured properties of the dispersions and UAl-phases such as thermal expansion, thermal and electrical conductivity, tensile strength, microhardness, and hot hardness are affected by the concentration of the dispersed phase and can be explained in the light of existing theoretical models. Owing to its potential as a high-flux reactor fuel with higher uranium content, the

preparation and properties of UAl_2–Al dispersions as well as the preliminary data about their stability under irradiation may be of particular interest. (auth)

24643 FORMATION OF COATINGS OF Al, Nb, Ge, AND THEIR MIXTURE ON NIOBIUM SUPPORTS BY ELECTROPHORESIS. Avgustinik, A. I.; Alekseev, V. P.; Zhuravlev, G. I.; Okhotnikova, S. I. (Leningrad Technological Inst.). J. Appl. Chem. USSR (Engl. Transl.); 48: No. 2, 426-428(Feb 1975).

Translated from Zh. Prikl. Khim.; 48: No. 2, 424-427(Feb 1975).

The optimal concentration C of the aluminum oxynitrate stabilizer at which the ξ potential has the highest value is $12 \pm 4 \cdot 10^{-4}$ M; coatings of good quality are obtained. The stability of the suspensions is highest at 60:40 ratio (vol %) of isobutyl alcohol to acetone. Study of the behavior of multicomponent suspensions in an electric field showed that the ξ potential and yield of deposit are intermediate between their values for the individual components. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 24142, 24185, 24553, 24570, 24572, 25237, 25286, 25444–25448, and 25450.

24644 (LA-UR-75-1415) EFFECT OF STRAIN RATE ON THE TENSILE PROPERTIES OF alpha- AND delta-STABILIZED PLUTONIUM. Hecker, S. S.; Morgan, J. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 13p. (CONF-750915-11). Dep. NTIS $4.00.

From 5th international conference on plutonium and other actinides; Baden-Baden, F.R. Germany (10 Sep 1975).

The tensile properties of unalloyed alpha-Pu and 3.4 at. percent Ga-stabilized delta-Pu were determined at strain rates from 10^{-5} to 100/s. Tests at strain rates less than 10^{-2}/s were conducted on an Instron Testing Machine; those at strain rates between 10^{-2} and 3/s on a closed-loop electrohydraulic MTS system; and those at strain rates greater than 3/s on a specially modified Charpy Impact Tester. Three lots of delta-Pu, one rolled and annealed and the other two cast and homogenized, were tested. The 0.2 percent yield strengths and ultimate tensile strengths increased by an average of 5.2 and 6.0 MPa per factor of 10 increase in strain rate. This increase was achieved without penalty in tensile ductility as measured by total elongation to fracture and by reduction in area. The isostatically pressed alpha-Pu specimens also showed a large increase in fracture stress with strain rate (34.3 MPa per factor to 10 increase in strain rate). The fracture was macroscopically brittle (plastic strains less than 0.3 percent) although we observed extensive evidence of microscopic flow in the ductile dimple-type appearance of the fracture surfaces. The strain to fracture appeared to exhibit a minimum at a strain rate of 10^{-2}/s. (auth)

24645 (LBL-3781) LATTICE IMAGE STUDIES OF ORDERED ALLOYS. Sinclair, R.; Dutkiewicz, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1975. Contract W-7405-ENG-48. 6p. (CONF-750825-4). Dep. NTIS $4.00.

From 33rd annual meeting of the Electron Microscopy Society of America; Las Vegas, Nevada, USA (11 Aug 1975).

Lattice imaging in electron microscopy was successfully applied to the study of ordering in alloys. The approach included computer simulation (Mg_3Cd), study of atomic arrangements near ordered lattice defects (Ni_4Mo), fringe changes during phase transformation, and identification of fringe periodicities in alloys quenched from above the critical ordering temperature. (DLC)

24646 (LBL-3794) INVESTIGATION OF ULTRA-HIGH STRENGTH Fe/4Cr/0.4C MARTENSITIC STEELS FOR IMPROVED TOUGHNESS. Rao, B. V. N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1975. Contract W-7405-ENG-48. 87p. Dep. NTIS $7.50.

Thesis.

Intergranular cracking in the as-quenched structures of vacuum melted Fe/4Cr/0.4C steel was investigated in terms of the heat treatment conditions. It was shown that the amount of carbon in solution and the martensite packet size are the two most important factors influencing cracking tendency. Non-conventional double heat-treatments have been designed in order to take advantage of higher austenitizing temperature and fine austentite grain size. These involved high temperature (greater than or equal to 1100°C) austenitizing during the first solution treatment followed by either interrupted quenching (M/sub s/-M/sub f/ range) or isothermal transformation to produce lower bainite and a subsequent 900°C grain refinement treatment to produce quench crack-free microstructures. Transmission and scanning electron microscopy and optical microscopy were used to characterize the microstructure. Tensile, CVN impact energy and plane strain fracture toughness tests were conducted to document the mechanical properties. The effects of substructural twinning, undissolved carbide morphology, auto-tempering and retained austenite on toughness properties are discussed to explain the observed variation in mechanical properties with heat-treatment. (LK)

24647 (ORNL-TM-4997) INTERRELATIONSHIPS BETWEEN CREEP LIFE CRITERIA FOR FOUR NUCLEAR STRUCTURAL MATERIALS. Booker, M. K.; Sikka, V. K. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 22p. AT.

Current elevated-temperature nuclear system design rules require consideration of the time to the onset of tertiary creep as one factor in the determination of design allowable stress intensity limits. However, tertiary creep data are often scarce, and little work has been done in their analysis. It is shown here that time to tertiary creep data may be analyzed by the same parametric techniques that were developed for treating rupture life data. Also, time to tertiary creep, t_3, is expressed as a function of rupture life, t/sub r/, by t_3 equals At/sub r/beta, where A and beta are material constants. Comparisons between these two prediction methods show that they produce similar results. (auth)

24648 (SAND-75-5126) COMPUTATIONAL INVESTIGATION OF THE EFFECTS OF BARRIER LAYERS ON THE PERMEATION OF HYDROGEN THROUGH METALS. Perkins, W. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 10p. (CONF-750925-2). Dep. NTIS $4.00.

From conference on effects of hydrogen on behavior of materials; Jackson, Wyoming, USA (7 Sep 1975).

Results of a computational investigation of the permeation behavior of oxide-coated metal membranes are presented. A steady-state permeation model was developed which promises to be useful in evaluation of oxide layers on metals as hydrogen permeation barriers. The pressure and thickness dependence of steady state permeation through oxide-coated metal membranes is described using plots of logarithmic functions. (JRD)

24649 (UCRL-50028-75-1, pp 1-8) THEORETICAL EOS GROUP. Grover, R. 1975.

In H-Division quarterly report, January–March 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Research activities are reported in programs on equations of state EOS of high-Z materials in the region of partial ionization, computer code development for display of EOS data, theoretical modeling of EOS, EOS from electron band theory and improved computer methods for EOS data. (JRD)

24650 (UCRL-50028-75-1, pp 13-16) EXPERIMENTAL EOS GROUP. Shaner, J. W. 1975.

In H-Division quarterly report, January–March 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Research on properties of materials at high pressures and temperatures is reported. Results of experiments on isobaric expansion of Ta, 304 stainless steel, C, and U are summarized along with measurements of sound velocity in shocked iron. In other work, models were developed to describe four-phase magnetic-diffusion properties of Ag and Au measurements of adiabats for solid Pb were made. Developmental work on double-pulsed-laser holographic interferometers and equipment for ultrahigh-pressure Hugoniot measurements is described. (JRD)

24651 (UCRL-50028-75-1, pp 17-21) DYNAMIC MATERIALS RESPONSE GROUP. Isbell, W. M. 1975.

In H-Division quarterly report, January–March 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

The studies of the Dynamic Materials Response Group are concerned with the response of materials to a wide range of pressure, time, and temperature. The approach in these studies involves combining theory, computations, and experiments to provide computer simulation of complex phenomena. Activities in research programs are reported on constitutive modeling and experimental characterization of porous metals, advanced experimental diagnostics for shock-wave and electron-beam studies, and development of gages for measuring impulses created in underground test environments. (auth)

24652 REDUCED TEMPERATURE PHASE DIAGRAMS OF THE SILVER–RARE EARTHS BINARY SYSTEMS. Ferro, R.; Delfino, S.; Capelli, R.; Borsese, A. (Univ., Genoa). J. Less-Common Met.; 42: No. 1, 13-18(Aug 1975).

Phase equilibria of the silver–rare-earth binary systems have been reported in reduced temperature diagrams (the reduced temperature being defined as the ratio between a characteristic temperature of the $Ag_xR.E.$ phase and the melting temperature of the corresponding R.E. metal, both in °K). The smooth trends of the various characteristic reduced temperatures, when plotted against the R.E. atomic number, have been demonstrated. On passing from the light- to the heavy rare earths, a correlation

has been found between the crossing of these curves and other phenomena, such as the disappearance of the $Ag_3R.E.$ phases, or the change of the $Ag_2R.E.$ phases from incongruently, to congruently melting compounds. The trends of the reduced-temperature curves have been briefly discussed in terms of the treatment suggested by Gschneidner together with the volumetric data known for the different $Ag_xR.E.$ phases. In addition, the characteristic data of the 1:1 Ag-R.E. compounds have been compared with those of the analogous Au-R.E. phases. (auth)

24653 EFFECT OF HYDROGEN ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF SOME BODY-CENTERED CUBIC NIOBIUM-PALLADIUM, NIOBIUM-PALLADIUM-MOLYBDENUM, AND NIOBIUM-PALLADIUM-TUNGSTEN ALLOYS. Robbins, C. G.; Muller, J. (Univ., Geneva). J. Less-Common Met.; 42: No. 1, 19-27(Aug 1975).

The introduction of appreciable quantities of hydrogen into $Nb_{(1-x)}Pd$ ($0.15 \leq x \leq 0.35$), $(Nb_{(1-x)}Pd_x)_{(1-y)}Mo_y$ ($0.15 \leq x \leq 0.24$; $0.0 \leq y \leq 0.1$), and $(Nb_{(1-x)}Pd_x)_{(1-y)}W_y$ ($x = 0.20$; $y \leq 0.1$) alloys by the electrolysis of H_2SO_4 gives rise to an increase in the superconducting transition temperature of these materials. For the Nb-Pd and Nb-Pd-Mo alloys, this effect is accompanied by the loss of body-centered cubic symmetry in the host metal lattice. (auth)

24654 SUPERCONDUCTIVITY OF DOPED LAYERS OF A15-PHASE NIOBIUM-ALUMINUM AND NIOBIUM-ALUMINUM-GERMANIUM. Mueller, A. (Siemens Research Labs., Erlangen, Ger.). J. Less-Common Met.; 42: No. 1, 29-41(Aug 1975).

The paper deals with the current-carrying capacity of superconducting layers Nb_3Al and $Nb_3(Al,Ge)$. The layers are produced in a two-step process on a niobium substrate by reaction between niobium and aluminum or aluminum-germanium, at 1880°C. By means of additives, introduced in gaseous form during the preparation, it is possible to increase the critical current density of the A15-phase to 2×10^5 A/cm^2 (5 T, 4.2°K). A description is given of doping with carbon, boron, phosphorus, and nitrogen, of the influence exercised on the superconducting current and critical temperature, and of the microstructure of the layers. (auth)

24655 TENSION-COMPRESSION EXPERIMENTS ON A FIBRE REINFORCED COMPOSITE OF Cu-W. Lilholt, H. (Danish Atomic Energy Commission, Risoe). pp 17-19 of Composites: Standards, Testing, and Design. Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From conference on composites standards testing and design; Teddington, Middlesex, UK (8 Apr 1974).

Specimens of single crystal copper with between 1 and 4 vol % of parallel tungsten wires of diameter 20μm were tested at room temperature in tension and compression through cycles of constant plastic strain amplitudes (Bauschinger tests). The data were used to evaluate the (experimental) back stress of the composites; a preliminary comparison with recent theories of back stresses in two-phase materials indicates that the composite at room temperature behaves as a perfect memory solid (no relaxation of dislocation structures). (auth)

24656 CONSTRAINT EFFECT IN STEADY-STATE CREEP OF FIBRE COMPOSITES. Pedersen, O. B. (Danish Atomic Energy Commission, Risoe). pp 33-35 of Composites: Standards, Testing, and Design. Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From conference on composites standards testing and design; Teddington, Middlesex, UK (8 Apr 1974).

The tensile creep strength of a unidirectional discontinuous fibre composite is discussed on the basis of an analysis of the equilibrium conditions in the matrix. This and previous theories predict that a volume fraction V_f of noncreeping fibers of aspect ratio l/d strengthens the matrix by the factor $\alpha\ V_f(l/d)^{1+1/n}$, where n is the stress exponent in the matrix creep law. Each theory yields an approximately constant α near unity. The magnitude of α seems to reflect the importance of the constraint effect. Preliminary experimental data is presented for Cu-W composites. (auth)

24657 WEAR PROPERTIES OF CAST VS PLASMA-SPRAYED LAVES INTERMETALLIC ALLOYS. Ferriss, D. P.; Cameron, C. B. (E. I. Du Pont de Nemours and Co., Wilmington, DE). J. Vac. Sci. Technol.; 12: No. 4, 795-799(1975).

From 2nd conference on strucure/property relationships in thick films and bulk coatings; San Francisco, CA (10 Feb 1975).

Cast and plasma-sprayed surfaces of the same composition were prepared containing a substantial amount of a Laves intermetallic phase. Other compositions, all containing metal carbides, were prepared by plasma spraying, detonation-gun deposition, casting, and powder metallurgy. The Alpha LFW-1 wear test used to compare wear properties of these surfaces in both room air and a nonlubricating liquid. No significant difference in wear and surface damage was evident between the cast and plasma-sprayed intermetallic wear surfaces. The performance of surfaces containing the intermetallic phase were equivalent to, or in most cases superior to, those whose hardness was due to metal carbides. (auth)

24658 STRUCTURE OF Ni-RICH Ni-Cr-B-Si COATING ALLOYS. Knotek, O.; Lugscheider, E.; Reimann, H. (Technische Hochschule, Aachen). J. Vac. Sci. Technol.; 12: No. 4, 770-772 (1975).

From 2nd conference on structure/property relationships in thick films and bulk coatings; San Francisco, CA (10 Feb 1975).

The structures of quaternary, nickel-rich Ni-Cr-B-Si alloys were analyzed at a constant boron content of 10 at. percent and a temperature of 850°C. The composition range for silicide formation was determined. In these quaternary alloys, known binary nickel silicides, nickel and chromium borides, and the ternary silico-boride Ni_4Si_2B were confirmed. A new composition for the W_5Si_3-type phase in the Ni-B-Si system was proposed. (auth)

24659 ELECTROCHEMICAL DETERMINATION OF POROSITY IN NICKEL ELECTROPLATES ON A URANIUM ALLOY. Weirick, L. J. (Sandia Labs., Livermore, CA). J. Electrochem. Soc.; 122: No. 7, 937-940(Jul 1975).

This study has shown that for U-Ti alloy specimens galvanically coupled to a nickel sheet in KCl electrolytes, the corrosion potential varies linearly with the logarithm of the exposed area fraction of uranium alloy. It was possible to calibrate the technique so that the exposed base metal area fractions of uranium alloy specimens plated with nickel could be estimated to a reasonable approximation. This technique is relatively nondestructive and offers the advantages of simplicity and high sensitivity, particularly at low porosities. (auth)

24660 GENERALIZED MAGNETIC SUSCEPTIBILITIES IN METALS: APPLICATION OF THE ANALYTIC TETRAHEDRON LINEAR ENERGY METHOD TO Sc. Rath, J. (Northwestern Univ., Evanston, IL); Freeman, A. J. Phys. Rev., B.; 11: No. 6, 2109-2117(15 Mar 1975).

A detailed study of the generalized susceptibility chi(vector q) of Sc metal determined from an accurate augmented-plane-wave method calculation of its energy-band structure is presented. The calculations were done by means of a computational scheme for chi(vector q) derived as an extension of the work of Jepsen and Andersen and Lehmann and Taut on the density-of-states problem. The procedure yields simple analytic expressions for the chi(vector q) integral inside a tetrahedral microzone of the Brillouin zone which depends only on the volume of the tetrahedron and the differences of the energies at its corners. Constant-matrix-element results have been obtained for Sc which show very good agreement with the results of Liu, Gupta, and Sinha (but with one less peak) and exhibit a first maximum in chi(vector q) at (0, 0, 0.31) 2pi/c [vs (0, 0, 0.35) 2pi/c obtained by Liu et al.] which relates very well to dilute rare-earth alloy magnetic ordering at vector q/sub m/ equals (0, 0, 0.28) 2pi/c and to the kink in the LA-phonon dispersion curve at (0, 0, 0.27) 2pi/c. (auth)

24661 ELECTROPHYSICAL PROPERTIES AND MECHANISM OF ELECTRON SCATTERING IN INDIUM ANTIMONIDE. Ermolovich, Yu. B. (Kiev Polytechnical Inst.). pp 56-60 of Elektronne Stroenie i Fizicheskie Svoistva Tverdogo Tela. Chast' 2. Samsonov, G. V. (ed.). Kiev; Izdatel'stvo Naukova Dumka (1972). (In Russian).

By using a value of 0.023 m_o for the effective electron mass at room temperature and a deformation potential $E_{ln} = 28.8$ eV on the assumption of acoustic scattering, it was possible to describe completely the temperature course of the electron mobility in the temperature interval from 300 to 600°K, if the variation in effective mass with temperature is taken into account. The good agreement of calculated electrophysical properties with the experimental data shows that the various properties of indium antimonide can be described by using the concept of electron scattering on acoustic lattice oscillations and on ionized impurities without invoking an optical mechanism and while taking into account the nonparabolic nature of the conductivity zone. (SJR)

24662 TWINNING PROCESSES IN Be AND ITS ALLOYS WITH Cu. II. Bosin, M. E.; Papirov, I. I.; Yakovenko, N. G. (Kharkov Inst. of Public Power Supply). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 120-121(1975). (In Russian).

The mechanical properties of single twinning layers in Be, and particularly deformation hardening, the role of accommodation slip during the various hardening stages, and the dependence of the Bauschinger displacement of the twinning boundary on the heating rate were investigated. In addition to the study of crystals of unalloyed Be, studies were also made of Be alloyed with 0.23 and 1.34 at.% Cu. The results are graphed and discussed on the assumption that the basic factor determining the mobility and

hardening of the twinning boundary can be considered the accompanying twinning of the slip. (JSR)

24663 DIFFUSION OF ^{63}Ni AND ^{55}Fe IN EUTECTIC COMPOSITIONS OF Ni–NiMo AND Fe–Fe_2Nb. Blinkin, A. M.; Ozhigov, L. S.; Somov, A. I.; Svinarenko, A. P.; Tortika, A. S.; Khripkov, Yu. F. (Kharkov State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 4, 126-127(1975). (In Russian).

On the basis of experimental data, equations are derived for diffusion. These equations show that the rate of diffusion of ^{63}Ni and ^{55}Fe in the eutectic is higher than in the matrix (solid solution of Mo in Ni and solid solution of Nb in Fe) and that there is a dependence of the diffusion rate on the rate of crystallization of the eutectic from the melt. The degree of deformation of the matrix of the composition was determined. The acceleration of the diffusion in the direction of the crystallized eutectic can be explained by the presence of thermal stresses and the plastic deformation of the matrix caused by them. The degree of deformation of the matrix in the composition, obtained at different crystallization rates, do not differ strongly from each other. (JSR)

24664 SOLENOIDAL EFFECT OF SCREW DISLOCATION. Larikov, L. N.; Dubrovs'kii, I. M.; Nikitin, B. G.; Bilets'kii, Yu. I. (Inst. of Metal Physics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 6, 544-546(Jun 1975). (In Ukrainian).

A macroscopic model of screw dislocation with a slot was used to show for the example of Mo that when an electric current is transmitted along the dislocation axis, there arises a potential difference on the slot edges. Theoretical representations of this phenomenon are considered and the constant of deformation perturbation is determined. (auth)

24665 EFFECT OF MAGNETO-STRICTIVE STRESS ON DEPOLARIZATION OF NEUTRON BEAMS IN POLYCRYSTALLINE TERBIUM. Baazov, N. G.; Barash, Ya. M.; Shilo, S. I. pp 170-176 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

Results of studies on the heating-cooling cycle over a wide temperature range in polycrystalline terbium indicate that terbium in the ferromagnetic state has a high magneto-striction in the base plane, which causes stresses in the grains. Stresses are also caused by a cycle of deep cooling and are retained in an antiferromagnetic field. After subsequent cooling cycles, these magneto-striction stresses continue to accumulate, which also leads to spreading of the magnetic transition to broader temperature intervals. The conclusions were verified experimentally. (TTT)

24666 ANISOTROPY OF SURFACE TENSION IN TRANSITION METALS. Desjonqueres, M. C.; Cyrot-Lackmann, F. (Centre National de la Recherche Scientifique, 38- Grenoble (France)). Surf. Sci.; 50: No. 1, 257-261(May 1975).

A systematic study of surface densities of states of cleaved transition metals including d band degeneracy and fully taking into account the charge rearrangement on the surface has recently been performed. It seems, therefore, interesting to use the results to study the variation of the surface tension and its anisotropy with the d band filling for the three crystalline structures: fcc, hcp, and bcc of transition metals. (auth)

24667 ADLAYER STRUCTURES OF CARBON MONOXIDE ON TRANSITION METAL SURFACES: A GEOMETRICAL MODEL OF LEED SUPERLATTICES AND A MOLECULAR DYNAMICS APPROACH TO CHEMISORPTION. Clarke, T. A.; Gay, I. D.; Mason, R. (Sussex Univ., Brighton (UK)). Surf. Sci.; 50: No. 1, 137-148(May 1975).

The (4 × 4) Mo (100)-CO, (5 × 5) Ni(100)-CO and (7 × 7) Cu (100)-CO surface structures formed by high coverage chemisorption of carbon monoxide on these transition metals are related to a simple geometrical model based on an hcp arrangement of the adlayer. The (4 × 2) structures observed for Pd(100) and Pt(100) are discussed. A molecular dynamics calculation of the adlayer geometry for carbon monoxide sorption on Ni (100) demonstrates the main features of the coverage dependence of the surface crystallography. (auth)

24668 RELAXATION PEAK ASSOCIATED WITH THE INTRINSIC INTERSTITIALS IN ZIRCONIUM DEFORMED AT LOW TEMPERATURE. Petit, J.; Quintard, M.; Ferron, G. (Poitiers Univ., 86 (France). J. Nucl. Mater.; 56: No. 3, 341-347(Jun 1975). (In French).

Internal-friction measurements carried out at three widely different frequencies (~1, 16, and 350 Hz) have allowed the detailed study of a damping peak in zirconium deformed at low temperature and not allowed to warm up beyond –68°C. The values obtained for the activation energy and the frequency factor (respectively 0.27 ± 0.02 eV, and $10^{13\pm0.8}$ s^{-1}), the narrowness of the peak—which allows it to be defined in terms of two simple relaxation times—and the fact that disappearance of this peak at –68°C is not directly consistent with a dislocation-pinning mechanism, lead to the postulate of a relaxation mechanism involving point defects of a paried oxygen self-interstitial type formed during low-temperature deformation. (auth)

24669 PHONON DISPERSION IN SCANDIUM AND YTTRIUM. Singh, J.; Prakash, S. (Punjab Univ., Chandigarh (India). Dept. of Physics). Phys. Lett., A; 53: No. 2, 164-166(2 Jun 1975).

Phonon dispersion relations for Sc and Y were calculated along [0001] and [01$\bar{1}$0] symmetry directions using Animalu transition metal model potential. (auth)

24670 STUDY OF THE MULBERRY ALLOY [U–7.5 Nb–2.5 Zr(%wt)]. Transformation Diagram on Continuous Cooling: Structures and Mechanical Properties. Couterne, A.; Collot, C.; Guillaume, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). J. Nucl. Mater.; 56: No. 2, 169-194(May 1975). (In French).

The phase transformations generated by controlled cooling from 900°C of the "Mulberry" alloy (U-7.5 wt% Zr) were studied by dilatometry, microscopy, and x-ray and electron diffraction. For slow cooling rates, three types of decomposition of the γ phase appear successively: (i) Between 600 and 550°C, grain boundaries and inclusion serve as nucleation sites for a cellular reaction, $\gamma \rightarrow \alpha + \gamma$; (ii) between 550 and 400°C, a continuous transformation of the matrix generates an α phase in the form of Widmanstatten plates, and (iii) below 400°C, the γ phase gives rise to an α'' phase, which has an ultrafine structure only imperfectly resolved by TEM. On rapid cooling, a tetragonal phase, γ_0, appears. Quenching generates the γ_s phase derived from γ, with a structure crystallizing in $I\bar{4}3m$ which has been described by Yakel. The various methods of investigation used have allowed the heating and cooling curves of the alloy to be obtained and thus the phase fields to be determined. In general terms, the structures formed are similar to those obtained by isothermal annealing below 600°C. Only the γ_s phase has useful mechanical properties, notably good ductibility. The other phases are characterized by extreme brittleness. (auth)

24671 SURFACE CRYSTALLOGRAPHY OF (W110) AND W(110)p(2 × 1)-0: THE POSITION OF W ATOMS. Buchholz, J. C.; Wang, G.-C.; Lagally, M. G. (Wisconsin Univ., Madison (USA)). Surf. Sci.; 49: No. 2, 508-528(Apr 1975).

The position of W atoms in the surface layers of clean (W110) and W(110) p (2 × 1)-0 was studied using Constant-Momentum-Transfer Averaging of LEED intensities. It is shown that the clean surface is not relaxed to an uncertainty of <0.06 Å. Analysis of superstructure beam intensity averages from W(110) p (2 × 1)-0 indicates that oxygen does not reconstruct W(110) at these coverages and below 1000°K. An upper limit of 0.05 Å can be put on the out-of-plane displacement of W atoms by the oxygen. Substrate beam averages from W(110) p (2 × 1)-0 verify the non-reconstruction. The use of CMTA for adsorbed-layer crystallography in general is briefly discussed. (auth)

24672 SOME MEASUREMENTS OF THE ANGULAR DISTRIBUTION AND POLARIZATION OF SURFACE PLASMON RADIATION FROM Ag FILMS. Braundmeier, A. J. Jr.; Hall, D. G. (Department of Physics, Southern Illinois University, Edwardsville, Illinois 62025, USA). Surf. Sci.; 49: No. 2, 376-392(Apr 1975).

Measurements of the angular distribution of the radiation emitted in the decay of surface plasmons on Ag films are presented. The radiation patterns have been measured in planes both parallel and perpendicular to the plane of incidence. Certain features of these patterns suggest that a scattering mechanism is present in the plasmon-photon conversion process that may be attributable to grain boundaries. A qualitative model is suggested for this grain boundary interaction in order to interpret the data. A brief comparison to the available theories is made. (a. th)

24673 EFFECTS OF HELIUM ON THE HIGH TEMPERATURE CREEP AND FRACTURE PROPERTIES OF Ni–6 PERCENT W. Matlock, D. K.; Nix, W. D. (Stanford Univ., Calif. (USA). Dept. of Materials Science and Engineering). J. Nucl. Mater.; 56: No. 2, 145-152(May 1975).

High-temperature constant true stress creep tests were performed on samples of Ni-6 percent W, which were injected with alpha particles to calculated helium concentrations of 0,4 and 4,0 ppM. The apparent activation energies for creep were determined to be between 260 kJ/mol at 20,7 MPa and 364 kJ/mol at 48,2 MPa and were found to be greater than 247 kJ/mol, the activation energy for creep in similar samples that did not contain helium. These high activation energies for the injected material are believed to be

fictitious in the sense that they are caused by the effects of helium on the shape of the creep curve. The helium bubbles present at grain boundaries promote premature fracture early in the primary creep stage by lowering the effective fracture-surface energy and thereby prevent the observation of steady-state creep in the injected material. (auth)

24674 ANGULAR DEPENDENCE OF THE MAGNETIC PROPERTIES OF TEXTURED POWDER SAMPLES OF THE ALLOY $Sm_{0.5}Pr_{0.5}Co_5$ AFTER VARIOUS TREATMENTS. Boidenko, V. S. (Yaroslavl State Univ., USSR). Izv. Vysah. Uchebn. Zaved., Fiz.; No. 3, 35-39(1975). (In Russian).

It was found that textured powders of the alloy $Sm_{0.5}Pr_{0.5}Co_5$ having a particle size of 1 to 50 microns prepared by mechanical comminution, and the anisotropic magnets obtained from the powder have a noticeable residual magnetization and coercive force on applying a magnetizing field perpendicular to the texture axis. From this behavior it is possible to assume as a first approximation that the powder samples are a mixture of two magnetic phases: an anisotropic and an isotropic phase. (SJR)

Radiation Effects

Refer also to abstract 24324.

24675 RADIATSIONNAYA FIZIKA TVERDOGO TELA I RADIATSIONNOE MATERIALOVEDENIE. I. (Radiation Physics of Solids and Radiation Material Science I). Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). 210p.

Fifteen papers are included. A separate abstract was prepared for each paper. (MCG)

For abstracts of individual papers see: 24324, 24598–24600, 24628, 24665, 24676–24681, and 24703–24705.

24676 APPARATUS FOR STUDYING IRRADIATED MATERIALS AND CARRYING OUT OF IN-PILE EXPERIMENTS AT LOW TEMPERATURES. Naskidashvili, I. A. pp 5-44 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

Diagrams and discussions are presented for equipment for testing materials under stress or bending, for measuring radiation expansion of materials, and for remote measurements of modulus of elasticity and internal friction of materials; intra-channel equipment for observing diffusion of gaseous fission products in solids and for observing surface properties of solids in nuclear radiation fields; low-temperature x-ray chambers with cold-sample overloading equipment and with stressing equipment; equipment for automatic recording of magnetic after-effect spectra, for de-accommodation of ferromagnetic metals and alloys, and for low-temperature calorimetric studies on materials. (TTT)

24677 EFFECT OF LOW-TEMPERATURE NEUTRON IRRADIATION ON INTERNAL FRICTION SPECTRUM AND ON INTERNAL FRICTION SPECTRUM AND ON DEFECTS OF MODULUS OF ELASTICITY OF PURE Nb. Serdobintsev, V. I.; Melik-Shakhnazarov, V. A.; Naskidashvili, I. A. pp 77-84 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

Pure Nb (less that 5 ppM impurities) was reactor-irradiated for 9 h at about 100°K with 9.6×10^{17} or 13.4×10^{17} n/cm^2 and then heated in the reactor to 360°K. Study of the properties indicated an increase in attenuation with increasing radiation dose. An attenuation in the alpha band is probably due to thermal activation of the transfer of dislocations. Attenuation maxima are absent in the presence of a defect of the modulus, which may be due to absence either of kinks and steps in "smooth" dislocations in the nondeformed metal or of point defects. The increase in internal friction caused by irradiation may result from elastic interaction of dislocations with point defects or to steps due to absorption by the dislocations of internodal atoms. (TTT)

24678 FEATURES OF THIRD ANNEALING STAGE OF RADIATION DEFECTS IN HYDROEXTRUDED Al. Topchyan, L. S.; Naskidashvili, I. A.; Konyaev, Yu. S.; Vygovskii, N. V. pp 85-92 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

Three-stage annealing of defects produced in hydroextruded 99.9998% pure Al after irradiation in the cryoscopic channel of a reactor was studied. Thermograms showed that in annealed samples of Al irradiated with doses of 1.1×10^{18} n/cm^2 at 125°K, there is a heat release of 1.2 cal/g-at. in the temperature interval 210-250°K. Hydroextruded Al irradiated similarly showed a heat release of 5.93 cal/g-at., the release starting at about 180°K. Metallographic sections (parallel and perpendicular) of hydroextruded aluminum are shown. Features of the structure of hydroextruded Al are small grains and a high density of the field in the stressed state. "Reservoirs" are formed which during irradiation absorb the defects created but only those with low migration are absorbed at irradiation temperatures of 120-125°K. In hydroextruded Al, along with closing of channels of recombination of internodal atoms–vacancy pairs there may be created annihilation channels. These two processes together create conditions for accumulation of excess vacancies. (TTT)

24679 RECOVERY OF ELECTRICAL RESISTANCE IN FAST-NEUTRON-IRRADIATED Al AND Al–Li ALLOY. Ali, R.; Martkoplishvili, G. S.; Naskidashvili, I. A.; Sorokina, S. I. pp 93-97 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsnierba (1974). (In Russian).

The effect of admixed atoms on the nature of annealing of point defects in Al was studied using 99.999% pure Al and Al–Li (2.5 at.%) alloy. Samples were irradiated at 100°K with a dose of 4×10^{17} n/cm^2 and then stored at liquid nitrogen temperatures. The curve of isochronous annealing of irradiated pure Al shows a clear peak of the resistance recovery at 200°K and a smaller one at 125°K, while that of the alloy shows a peak at 215°K. Analysis of the data shows first-order kinetics for the annealing process in the first stage (130 to 170°K). The second-order kinetics in the third stage may be related to recombination of internodular atoms with vacancies although migration of vacancies with formation of divacancies is not excluded. (TTT)

24680 EFFECT OF POINT DEFECTS ON THE INITIAL MAGNETIC SUSCEPTIBILITY OF NONORDERED NICKEL ALLOYS. Akopov, F. Kh.; Dekhtyar, I. Ya.; Naskidashvili, I. A.; Ratishvili, I. G. pp 144-169 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Isdatel'stov Metsniereba (1974). (In Russian).

The effect of neutron irradiation on the initial magnetic susceptibility, χ^0, of ferromagnetic alloys Ni–Cu and Ni–Ga with different contents of the nonmagnetic alloying element was studied. The alloys were irradiated at about 100°K and the susceptibility was measured at temperatures from 100 to 360°K. The data indicate that with the same radiation dose, the absolute and relative changes in the initial magnetic susceptibility decreased with increase in concentration of the nonmagnetic atoms present. With increase in the dose the change in $\Delta\chi^0$ increases but, because of radiation-stimulated annealing, this increase is not proportional to the radiation dose. The temperature change in $\Delta\chi^0$ depends on both the relative and the absolute temperature. The temperature interval studied apparently coincides with the high-temperature region of the aftereffect zone, which corresponds to the third aftereffect zone in pure nickel. (TTT)

24681 EFFECT OF DEFORMATION AND LOW-TEMPERATURE NEUTRON IRRADIATION ON INTERNAL FRICTION AND MODULUS OF ELASTICITY OF POLYCRYSTALLINE COPPER. Ashimov, S. M.; Melik-Shakhnazarov, V. A.; Tsakadze, D. C. pp 177-185 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

Experimental data are presented which indicate that by using low-frequency apparatus for measuring internal friction and combined low-temperature plastic deformation and reactor irradiation, it may be possible to explain new and interesting details of dislocation attenuation and defect in the modulus of elasticity. The data are presented as graphs of the dependence of the decrease in attenuation change in properties on the total neutron dose. (TTT)

24682 SELF-IRRADIATION OF A URANIUM–PLUTONIUM–MOLYBDENUM CENTERED CUBIC ALLOY. Zanghi, J. P.; Calais, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). J. Nucl. Mater.; 56: No. 2, 208-212(May 1975). (In French).

Measurements were made of the length changes due to self-irradiation damage at 4.2°K for over 1300 h in a U–Pu–Mo bcc alloy (containing 20 at% plutonium and 15 at% molybdenum) stabilized by quenching. These are the first measurements of this type carried out on a bcc alloy. The initial rate of increase of $\Delta l/l$ was 2.3×10^{-7} h^{-1}. If it is assumed that each α disintegration forms 1800 Frenkel pairs, it is found that Frenkel pairs have a formation volume equal to 0.5 atomic volume. (auth)

24683 CONTRIBUTION OF DISLOCATION LOOPS TO RADIATION GROWTH AND CREEP OF ZIRCALOY-2. Carpenter, G. J. C.; Northwood, D. O. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). J. Nucl. Mater.; 56: No. 3, 260-266(Jun 1975).

Annealed specimens of Zircaloy-2 have been examined using

transmission electron microscopy after irradiation to various fluences up to 1×10^{26} n.m^{-2}(E > 1 MeV) at 573°K. Measurements of the size and concentration of the radiation-induced defects show that they make a negligible contribution to radiation growth. An alternative mechanism is suggested, based on the bias interaction between interstitials and dislocations. A specimen of cold-worked and stress-relieved Zircaloy-2, creep tested at 138 MPa in a reactor at 573°K, was also examined. It was shown that the total number of point defects in the form of clusters was the same as in an unstressed, annealed specimen. It can be concluded that the stress-induced orientation of dislocation loops makes a negligible contribution to radiation creep of Zircaloy-2 at 573°K, regardless of the magnitude of the applied stress. (auth)

24684 IRRADIATION DAMAGE OF NICKEL IN A HIGH-VOLTAGE ELECTRON MICROSCOPE. Das, G.; Mitchell, T. E. (Case Western Reserve Univ., Cleveland, Ohio (USA). Dept. of Metallurgy and Materials Science). J. Nucl. Mater.; 56: No. 3, 297-306(Jun 1975).

Electron irradiation damage in high-purity annealed and 20% deformed nickel was studied using a high-voltage electron microscope (HVEM) operating at 650 kV. The effects of temperature of irradiation, electron dose, and cold work on point-defect clustering in general and void formation in particular have been investigated. Both faulted and unfaulted dislocation loops were observed during irradiation at 240 to 500°C; multilayer dislocation loops were observed at the higher temperatures. Voids exhibited a cubic shape at low dose with a nearly homogeneous distribution in annealed and an inhomogenous distribution in 20% deformed nuclei. The average void size for annealed nickel was larger than that for 20% deformed nickel and the void growth rate was found to be higher for annealed nickel. In annealed nickel, the void concentration increased up to ~14 dpa and then decreased, while in 20% deformed nickel it increased up to ~35 dpa. Swelling was considerably reduced by cold work compared to annealed nickel. These observations are discussed with emphasis on the role of dislocation density in the nucleation and growth of voids and swelling. (auth)

24685 TRAPPING OF LOW-ENERGY HELIUM IONS IN NIOBIUM. Behrisch, R.; Boettiger, J.; Eckstein, W.; Roth, J.; Scherzer, B. M. U. (Max-Planck-Institut fuer Plasmaphysik, Garching; Muenchen (F. R. Germany)). J. Nucl. Mater.; 56: No. 3, 365-367(Jun 1975).

The ^{3}He(d,p)^{4}He reaction with a Q value of 18.341 MeV is used to determine absolutely the ^{3}He trapped after implantation in a nobium single crystal at room temperature in a random direction. (auth)

24686 SELF-INTERSTITIALS IN ALUMINIUM. Schuele, W. (Physics Division, CCR Euratom, Ispra, Italy). J. Nucl. Mater.; 56: No. 3, 368-370(Jun 1975).

A temperature-dependent enhancement of diffusion of gold and copper in pure aluminum during irradiation by neutrons was reported recently. This enhancement is linear on an Arrhenius plot. It was further observed that, for the temperature range in which the diffusion coefficient is temperature-dependent, the diffusion coefficient is also proportional to the square root of the flux for a constant irradiation temperature. It appears that this is the first time such relations have been found in a (nearly) pure metal. In copper alloys with zinc, aluminum, nickel, iron or gold, in gold–silver and in silver–zinc alloys, such flux and temperature dependences have been observed frequently. However, the interpretation of the experimental results for pure aluminum differs from the interpretation for the alloys. It is shown how this discrepancy can be eliminated and how the results obtained for aluminum are relevant to open questions concerning the identification of self-interstitials in aluminum. (auth)

24687 INFLUENCE OF THE FAST NEUTRON DOSE ON THE FORMATION OF VOIDS IN ALUMINIUM. Risbet, A.; Brebec, G.; Levy, V. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Section de Recherches de Metallurgie Physique); Lanore, J.-M. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service d'Etudes des Reacteurs et de Mathematiques Appliquees). J. Nucl. Mater.; 56: No. 3, 348-354(Jun 1975). (In French).

The results of neutron irradiation of aluminum at 55°C under a fast flux of $(1.4 \pm 0.2)\ 10^{14}$ n · cm^{-2} s^{-1} to doses ranging between 10^{19} and 3×10^{21} n · cm^{-2} are presented. Experimental observations suggest that dislocations play an important role in void nucleation and growth. Monte Carlo calculations of void growth in the presence of a dislocation describe reasonably well the experimental results. (auth)

24688 SIMULATION OF CTR NEUTRON RADIATION DAMAGE BY HEAVY ION IRRADIATION. Marwick, A. D. (UKAEA Research Group, Harwell, Atomic Energy Research Establishment). J. Nucl. Mater.; 56: No. 3, 355-358(Jun 1975).

The primary recoil spectrum in niobium under 33 MeV self-ion bombardment is calculated and compared with a calculation by Logan et al. of the same spectrum under neutron irradiation in a controlled thermonuclear reactor. The two spectra are similar, which suggests that a close simulation of CTR neutron radiation damage by ion bombardment will be possible. The displacement rate per projectile is found to be 3.7×10^5 times higher for ions than for neutrons, allowing very high neutron fluxes, up to about 10^{18} cm^{-2}/sec^{-1}, to be simulated with existing accelerators. (auth)

24689 EFFECT OF PRESTRAIN AT 77K ON THE PLASTIC DEFORMATION OF ZIRCALOY-2. Bergqvist, H.; Bergenlid, U. (Aktiebolaget Atomenergi, Studsvik (Sweden)). J. Nucl. Mater.; 56: No. 3, 314-318(Jun 1975).

The tensile properties of unirradiated and neutron-irradiated Zircaloy-2 specimens have been studied after a pre-straining treatment at 77°K. The prestrain was found to increase the rate of work hardening and the uniform and total elongations of unirradiated transverse specimens, as observed by Reed-Hill and Dahlberg in the case of zirconium. Prestrain at 77°K had a small effect on the stress-strain behavior of irradiated specimens. Metallographic examination showed extensive {11$\bar{2}$1} twinning in all prestrained specimens. (auth)

24690 NUCLEATION AND EARLY GROWTH OF INTERSTITIAL DISLOCATION LOOPS IN IRRADIATED MATERIALS. Hayns, M. R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment. J. Nucl. Mater.; 56: No. 3, 267-274 (Jun 1975).

A hierarchy of rate equations is solved to describe the homogeneous nucleation of interstitial dislocation loops in irradiated materials. Calculations for graphite and M316 stainless steel have been performed. The concept of nucleation time is examined and a procedure is adopted which gives a useful criterion for defining the end of the nucleation period. Calculations have been performed which demonstrate the effects of temperature, dose rate, and network-dislocation density on the nucleation and final concentration of interstitial loops. The assumption that di-interstitial atom pairs are stable against thermal dissociation is examined and found to be appropriate for the conditions used in this work. (auth)

24691 RADIATION-INDUCED DEFECT BUILDUP AND RADIATION-ENHANCED DIFFUSION IN A FOIL UNDER ENERGETIC BOMBARDMENT. Lam, N. Q. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 56: No. 2, 125-135(May 1975).

The distribution of interstitials, monovacancies, and vacancy aggregates containing two to six vacancies in a silver foil under irradiation was calculated as a function of both distance from the surface of the foil and irradiation time by numerically solving the rate equations for various temperatures (0 to 250°C) and internal sink concentrations (0,10^{-5} and 10^{-3}). The mobile defects (interstitials, monovacancies, divacancies and trivacancies) were assumed to react with each other, to annihilate at fixed sinks and to diffuse to the surface. Vacancy clusters larger than trivacancies were considered to be immobile, able to grow, but not dissociate. Humps on the steady-state concentration profiles for monovacancies and immobile vacancy clusters were found near the surface of a foil, provided the irradiation temperature and sink density were low and/or the defect production rate was quite high. The radiation-enhanced diffusion coefficient, D/sub rad/, of the material was calculated from the diffusivities of mobile defects and their steady-state concentrations, as a function of temperature, sink concentration, and Frenkel-pair production rate. (auth)

24692 DISLOCATION STRUCTURE OF COPPER IRRADIATED BY AN INTENSE ELECTRON BEAM FOR A PERIOD OF 10^{-8} TO 10^{-7} SECONDS. Rotshtein, V. P.; Bushnev, L. S.; Proskurovskii, D. I. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 130-131(1975). (In Russian).

Annealed copper foil disks 3 mm in diameter and 50 microns thick were subjected to intense electron bombardment, and the irradiated samples were made thinner by electropolishing in concentrated phosphoric acid at a voltage of 0.9 V until an opening was formed in the center of the disk. The thinning was carried out from the unirradiated side of the sample. The thin edges of the opening were used for electron-microscopic studies. An increase in dislocation density was found in the zone where the electron beam interacted with the copper disk. At a power of 2×10^7 watts/cm^2 a dislocation density of 10^{10} cm^{-2} was found. Signs of twinning were observed. Plastic deformation penetrated to a depth of 10 to 50 microns depending on the intensity of the electron beam. (SJR)

Other Materials

Refer also to abstracts 24334, 24544, 24655, 24656, 25271, and 25312.

24693 (LBL-3774) BORON PRECIPITATES IN ION IMPLANTED SILICON. Wu, W. K.; Washburn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1975. Contract W-7405-ENG-48. 3p. (CONF-750825-1). Dep. NTIS $4.00.

From 33rd annual meeting of the Electron Microscopy Society of America; Las Vegas, Nevada, USA (11 Aug 1975).

Long rod-like defects are observed in ion implanted silicon when boron is present either as a prior dopant addition or as the implanted species. Results of recent work indicates that these defects have the characteristics of narrow extrinsic dipoles or elongated dislocation loops and that there are two different types along each of the six broken bracket 110 broken bracket directions. An annealing kinetics method has been used to identify the nature of these defects formed during post-implantation annealing in boron ion (100 keV) implanted silicon irradiated at room temperature to a dose of $2 \times 10^{14}/cm^2$. It is concluded that at least two different kinds of rod-like defects exist in boron ion implanted silicon. From the activation energy energy for shrinkage, it is also concluded that one type (anti A) is composed largely of boron atoms. (auth)

24694 (LBL-3782) DIRECT OBSERVATION OF RADIATION INDUCED PRECIPITATION IN HIGH VOLTAGE ELECTRON MICROSCOPE. Wu, W. K.; Washburn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1975. Contract W-7405-ENG-48. 4p. (CONF-750825-2). Dep. NTIS $4.00.

From 33rd annual meeting of the Electron Microscopy Society of America; Las Vegas, Nevada, USA (11 Aug 1975).

Boron- and phosphorus-doped Si was irradiated by 650-keV electrons at 620°C. Long, rod-like defects were observed in the B-doped but not in the P-doped samples, which is consistent with the idea that the rods are B precipitates; the substitutional B is probably replaced by Si self-interstitials. (DLC)

24695 (ORNL-tr-4006) SUPERCONDUCTING CARBON FIBER. Koyama, T.; Mori, K. 31 Dec 1972. Translation by H. Kubota of Japanese Patent 1970-123336. 5p. Dep. NTIS $4.00.

A new superconducting material may be prepared by the incorporation of a metal or a metal salt into carbon fiber prepared by firing petroleum, coal family pitch, charcoal, or organic fiber (polyacrylonitrile). Nine examples are given. (DLC)

24696 COMPOSITES: STANDARDS, TESTING, AND DESIGN. Proceedings of the Conference held at Teddington, England, April 8–9, 1974. Guildford, Eng.; IPC Science and Technology Press Ltd. (1974). 163p. (CONF-7404105-).

The 27 papers cover such topics as: mechanics, engineering design, advanced composites, weakening by micro defects, applications, surface treatment of fibers, acoustic emission and fatigue, cements and concretes, thermoplastics, stiffness, polycarbonate, dynamic testing, and compression and Charpy impact strength. Separate abstracts were prepared for 2 papers dealing with Cu–W fiber composites. (DLC)

For abstracts of individual papers see: 24655 and 24656.

24697 COMPOSITES: STATE OF THE ART. Conference held at Detroit, Michigan, October 18–21, 1971. Weeton, J. W.; Scala, E. (eds.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers, Inc. (1974). 371p. (CONF-711089-).

The seven chapters of this book summarize the state of art of composites from a practical viewpoint. Some attention was paid to mechanics or micromechanics. (DLC)

For abstracts of individual papers see: 24698–24701.

24698 HIGH-PERFORMANCE FIBER REINFORCED POLYMERS. Fleck, J. N.; Hanby, K. R. (Battelle Columbus Labs., OH). pp 25-66 of Composites: State of the Art. Weeton, J. W.; Scala, E. (eds.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers, Inc. (1974).

From proceedings of the metallurgical society of AIME; Detroit, Michigan, USA (18 Oct 1971). See CONF-711089-.

New fibers which are stiffer than fiberglas have resulted in advanced reinforced plastics. A review is presented of matrix and fiber materials; the latter includes glass, boron, carbon, and organic (PRD-49) fibers. Fabrication (both primary and secondary) and properties of these composites are next reviewed. Environmental degradation is also considered. (15 tables, 12 fig, 43 references.) (DLC)

24699 SURVEY OF ALUMINUM MATRIX COMPOSITES. Toth, I. J.; Brentnall, W. D.; Menke, G. D. (TRW Inc., Cleveland). pp 139-207 of Composites: State of the Art. Weeton, J. W.; Scala, E. (eds.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers, Inc. (1974).

From proceedings of the metallurgical society of AIME; Detroit, Michigan, USA (18 Oct 1971). See CONF-711089-.

This is a review of the current stage of development of fiber reinforced Al matrix composites: primary and secondary fabrication, physical and mechanical properties, environmental effects, applications, current and projected costs of raw material and composites, and future developments. Boron and beryllium are among the filament materials. (101 references, 32 fig.) (DLC)

24700 FIBER REINFORCED TITANIUM ALLOY COMPOSITES. Sippel, G. R.; Herman, M. (GMC, Indianapolis). pp 211-251 of Composites: State of the Art. Weeton, J. W.; Scala, E. (eds.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers, Inc. (1974).

From proceedings of the metallurgical society of AIME; Detroit, Michigan, USA (18 Oct 1971). See CONF-711089-.

The more important titanium matrix composites studied to date are composed of titanium alloy matrices, such as Ti 6Al–4V, reinforced with filaments of boron, silicon carbide, or sapphire, as well as with wires of beryllium or refractory metal alloys. The primary fabrication techniques for these materials involve vacuum hot pressing at 1300 to 1600°F, alternate layers of titanium alloy matrix foils, and suitably aligned filament mats. The more ductile reinforcements such as beryllium, have been incorporated into titanium matrix composites by coextrusion. Fabrication of composite gas turbine engine fan blades from both boron (SiC coated) and beryllium reinforced Ti 6Al–4V alloy is described. Feasibility studies have been made in the fabrication of Boron/Ti 6Al–4V composite rings for possible gas turbine engine disc applications. Mechanical properties of various titanium matrix composite systems are presented and demonstrate the attractive elevated temperature properties of some systems to 1000°F. (35 fig, 6 tables) (auth)

24701 FIBER REINFORCED SUPERALLOYS, CERAMICS, AND REFRACTORY METALS, AND DIRECTIONALLY SOLIDIFIED EUTECTICS (HEAT-RESISTANT COMPOSITES). Weeton, J. W. (Lewis Research Center, Cleveland). pp 255-365 of Composites: State of the Art. Weeton, J. W.; Scala, E. (eds.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers, Inc. (1974).

From proceedings of the metallurgical society of AIME; Detroit, Michigan, USA (18 Oct 1971). See CONF-711089-.

High-temperature composites have been shown to have been shown to have excellent elevated-temperature tensile and stress-rupture strengths and specific strengths. Tungsten alloy fiber-reinforced superalloys have been demonstrated to have stress-rupture strengths at 2000°F superior to superalloys and sufficient impact resistance for gas turbines. Recently developed tungsten alloy fibers should permit production of composites with use-temperature (gas turbine blades, vanes) as high as 2400°F. Thermal fatigue is expected to be a problem requiring solution for some of the composites. Directionally solidified eutectics have use-temperatures to 2200°F, and probably will be utilized in advanced gas turbines before the tungsten alloy/superalloy matrix composites. Their main problem is associated with the direction and perfection of growth of strong whiskers or lamina in irregularly shaped components. Artificially made whisker composites are believed to warrant serious consideration. Use-temperatures of refractory metal matrix composites can be as much as 2500°F for Nb matrix composites and over 3000°F for W matrix composites. Oxidation resistance would be the main problem for applications such as gas turbines, but in inert atmospheres, such materials should have application. Ceramic matrix composites with use-temperatures ranging from 1800°F to over 3000° are possibilities. Progress in making impact-resisting ceramic composites is encouraging, but additional successes are required. Stationary, large, turbines for power generation may make use of refractory fiber/superalloy matrix, ceramic matrix, and coated refractory matrix composites. Such an application may capitalize on the high-temperature strength and high use-temperatures of the composites, which, in turn, will enhance engine performance. Steady-state operation of large turbines may eliminate almost any of the potential problems from impact, thermal cycling, and spalling of oxides that can result from the cyclic operation of turbojet gas turbines, turbines contemplated for mobile ground use, or power generating turbines to be used intermittently. (127 references, 62 fig, 22 tables) (DLC)

24702 POSTIRRADIATION ALKALI MIGRATION. Primak, W. (Argonne National Lab., IL). J. Electrochem. Soc.; 122: No. 7, 1002-1004(Jul 1975).

A number of commercial optical glasses were subjected to ion bombardment with 140-keV D^+ ions and the resulting decoration with droplets were observed over the summer months in a laboratory with the relative humidity varying from 40 to 60 percent and the temperature controlled to within 1^0 of 24^0C. The droplets reappeared after washing and some became solid when the relative humidity was dropped. Water wets the bombarded areas more readily than non-bombarded areas. It is assumed that the liquid droplets are alkali hydroxide solutions and the deposits are probably carbonates. The freeing of the alkali ions was attributed to a chemical or structural change induced by the ion bombardment. Electrical charge effects and the effects of surface impurities may be involved. (JSR)

24703 EFFECT OF INTERACTION OF ANISOTROPIC DEFECTS WITH DISLOCATIONS ON MECHANICAL PROPERTIES OF IRRADIATED CRYSTALS. Dokhner, R. D.; Topchyan, I. I. pp 45-57 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

Mathematical equations are developed for the electric interaction of regional dislocations with anisotropic defects of the ⟨100⟩ type in NaCl-type ionic crystals with consideration of modular effect of the interaction and the size of the defect. Calculations were made on a computer. At 300°K and a load of 0.5 kg/mm^2, the rate of movement of the dislocations in crystals irradiated in the free state is less than that in crystals irradiated in the stressed state. The interactions discussed may play a significant role in changing the properties of crystals by irradiation. (TTT)

24704 EFFECT OF ANISOTROPIC DEFECTS ON RADIATION STRENGTHENING OF LiF CRYSTALS. Paperno, I. M. pp 58-67 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

LiF crystals containing 10^{-2} at.% Mg were irradiated with 1×10^{15} n/cm^2 at reactor temperature, and the temperature dependence of the viscosity limit and other deformation properties was studied from 150 to 500°K. The curve of temperature vs viscosity limit indicates that the barriers limiting the mobility of dislocations in irradiated, nonirradiated, and stressed crystals are identical. Defects hindering movement of dislocations appear to be tetragonally located in the ⟨110⟩ direction and to interact with regional dislocations. Irradiation increases the defect concentration and changes in anisotropic complexes and forming a higher potential barrier, which strengthens the crystal. (TTT)

24705 RADIATION COLLOIDS OF LITHIUM IN THIN LiF FILMS. Metreveli, P. I.; Natsvlishvili, G. I. pp 197-208 of Radiatsionnaya Fizika Tverdogo Tela i Radiatsionnoe Materialovedenie. I. Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

In a field of very high radiation-thermal activity it is possible to separate 350-Å lithium particles by irradiation of a 2000-Å thick film for 40 min. Outside this field, colloid separation is very slow. Metallic particles are formed also in a 20-min irradiation, but this is a minimum irradiation time. Lithium particles were not observed after 10 min irradiation. Probably colloids in this early irradiation stage are very small and randomly dispersed in the matrix lattice. In the crystalline lattice there are defects which increase with the appearance of the second phase. Change in the boundaries of these defects in the strengthening of colloid reflexes confirm that as the number of metallic particles increases, they readily diffuse in the region of the defects. (TTT)

24706 ANALYSIS OF TRANSIENT PHENOMENA IN CRYSTALLINE AND LIQUID STRUCTURES USING NEUTRON TIME-OF-FLIGHT TECHNIQUES. Nimura, N.; Muto, M. (Tohoku Univ., Sendai (Japan). Lab. of Nuclear Science). Nucl. Instrum. Methods; 126: No. 1, 87-92(15 May 1975).

The neutron time-of-flight technique is promising for the study of transient phenomena in solids and liquids. This method can be applied to the crystalline sample an external field (for example an electric field) pulsed with the same frequency as the neutrons. The method of observation of the transient phenomena (the polarization reversal of $NaNO_2$ by an external electric field) and the apparatus for the experiment are explained in detail. Several subsidiary but interesting applications of this method are also preliminarily reported. (auth)

24707 MICROSTRUCTURAL DISORDER AND THE MECHANICAL PROPERTIES OF CARBON FIBRES. Wicks, B. J. (Aeronautical Research Labs., Melbourne (Australia)). J. Nucl. Mater.; 56: No. 3, 287-296(Jun 1975).

The effect of fast neutron irradiation on the mechanical and microstructural properties of carbon fibers heat-treated to various stages of graphitization has been investigated. Changes in selected crystallinity parameters were used to monitor the microstructural disorder induced in each fiber type by three different irradiation doses. Associated changes in fracture strength and Young's modulus are related to the dependence of dislocation mobility on short-range microstructural damage. (auth)

24708 RADIATION GENERATION OF CATION VACANCIES IN ALKALI HALIDE CRYSTALS. Vorob'ev, A. A.; Annenkov, Yu. M.; Pichugin, V. F.; Frangul'yan T. S.; Nesterenko, A. P. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 135-136(1975). (In Russian).

A study is made of the electrical conductivity of NaBr, KCl, and KBr crystals irradiated with 70 keV x rays at various temperature from 300 to 450°K. The increase in electrical conductivity is associated with a change in concentration of free cation vacancies, if the irradiation temperature is above room temperature. The generation of free cation vacancies is manifested at high-temperature in crystals. The injection of alkali metal ions into the internodal points is accomplished as a result of the energy which is evolved from an electron-hole recombination. (SJR)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

24709 (BNWL-1518) PACIFIC NORTHWEST LABORATORY MONTHLY ACTIVITIES REPORT, SEPTEMBER 1970. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1970. Contract AT(45-1)-1830. 54p. Dep. NTIS $5.75.

Declassified 28 Apr 1975.

This monthly activities report includes details of technical assistance to Douglas United Nuclear, Atlantic Richfield Hanford Co., and the Hanford Plant. (JGB)

24710 (BNWL-B-424) DECISION MODEL INCORPORATING UTILITY THEORY AND MEASUREMENT OF SOCIAL VALUES APPLIED TO NUCLEAR WASTE MANAGEMENT. Litchfield, J. W.; Hansen, J. V.; Beck, L. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1975. Contract AT(45-1)-1830. 58p. Dep. NTIS $5.45.

A generalized computer-based decision analysis model was developed and tested. Several alternative concepts for ultimate disposal have already been developed; however, significant research is still required before any of these can be implemented. To make a choice based on technical estimates of the costs, short-term safety, long-term safety, and accident detection and recovery requires estimating the relative importance of each of these factors or attributes. These relative importance estimates primarily involve social values and therefore vary from one individual to the next. The approach used was to sample various public groups to determine the relative importance of each of the factors to the public. These estimates of importance weights were combined in a decision analysis model with estimates, furnished by technical experts, of the degree to which each alternative concept achieves each of the criteria. This model then integrates the two separate and unique sources of information and provides the decision maker with information as to the preferences and concerns of the public as well as the technical areas within each concept which need further research. The model can rank the alternatives using sampled public opinion and techno-economic data. This model provides a decision maker with a structured approach to subdividing complex alternatives into a set of more easily considered attributes, measuring the technical performance of each alternative relative to each attribute, estimating relevant social values, and assimilating quantitative information in a rational manner to estimate total value for each alternative. Because of the explicit nature of this decision analysis, the decision maker can select a specific alternative supported by clear documentation and justification for his assumptions and estimates. (JGB)

Accountability and Safeguards

Refer also to abstract 24458.

24711 INTRUSION DETECTOR SELF-TEST SYSTEM. Schwarz, F. (to U. S. Energy Research and Development Administration). US Patent Application 533,741. Filed date 17 Dec 1974. 16p.

An intrusion detection system is described, which automatically makes periodic tests of the operability of the system and provides an alarm in the event of a malfunction during the supervisory self-check regimen. This alarm is distinguishable from the normal intrusion alarm. (auth)

Disposal and Storage

Refer also to abstracts 24165, 24202, 24203, and 24357.

24712 (ARH-CD-133C) PRODUCTION AND WASTE MANAGEMENT DIVISION WASTE STATUS SUMMARY. Progress Report, 1 July 1974–30 September 1974. Anderson, J. D. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 27 Nov 1974. 12p. Dep. NTIS $4.00.

Tabulated data on the status of waste farms and the performance of the waste solidification system are included. (JGB)

24713 (ARH-SA-218) IMMOBILIZATION OF AQUEOUS RADIOACTIVE CESIUM WASTES BY CONVERSION TO ALUMINOSILICATE MINERALS. Barney, G. S. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2130. 34p. (CONF-750673-1). Dep. NTIS $4.25.

From 30th northwest regional meeting American Chemical Society; Honolulu, Hawaii, USA (12 Jun 1975).

Radioactive cesium (primarily ^{137}Cs) is a major toxic constituent of liquid wastes from nuclear fuel processing plants. Because of the long half-life, highly penetrating radiation, and mobility of ^{137}Cs, it is necessary to convert wastes containing this radioisotope into a solid form which will prevent movement to the biosphere during long-term storage. A method for converting cesium wastes to solid, highly insoluble, thermally stable aluminosilicate minerals is described. Aluminum silicate clays (bentonite, kaolin, or pyrophyllite) or hydrous aluminosilicate gels are reacted with basic waste solutions to form pollucite, cesium zeolite (Cs-D), Cs-F, cancrinite, or nepheline. Cesium is trapped in the aluminosilicate crystal lattice of the mineral and is permanently immobilized. The identity of the mineral product is dependent on the waste composition and the SiO_2/Al_2O_3 ratio of the clay or gel. The stoichiometry and kinetics of mineral formation reactions are described. The products are evaluated with respect to leachability, thermal stability, and crystal morphology. (auth)

24714 (BNWL-1869) CORROSION OF MILD STEEL TANK LINERS EXPOSED TO SIMULATED SOLIDIFIED ALKALINE HIGH-LEVEL WASTE. Maness, R. F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1974. Contract AT(45-1)-2130. 15p. Dep. NTIS $4.00.

Mild steel coupons and stressed C-rings exposed to simulated solidified waste for 7, 12, and 22 months exhibited both general and pitting corrosion but no stress corrosion cracking. Weight loss measurements indicated corrosion rates ranging from 0.7 to 4.7 mils/year after 22 months exposure. Corrosion rates were nearly the same for specimens exposed at 60 and 80°C. Corrosion rates at 95°C were about one-half those found at 60 and 80°C. Increasing the water content from 5 to 15 percent increased general corrosion by a factor of about two. Pitting attack occurred on all specimens exposed to high-alkali waste. The pitting rate appeared to be approximately linear with respect to time during the 22-month exposure period. A maximum pit depth of 20 mils was observed. Corrosion of specimens exposed to waste prepared from solutions in which the caustic content had been largely neutralized with phosphoric, sulfuric, or nitric acid was very light, less than .01 to 0.6 mils/year with no pitting. (auth)

24715 (BNWL-1930) TECHNIQUES FOR DETERMINING MECHANICAL PROPERTIES OF WASTES AND SAMPLING WASTE TANK CONTENTS. Lawrence, R. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1975. Contract AT(45-1)-1830. 26p. Dep. NTIS $4.00.

At the request of the Atlantic Richfield Hanford Company, Battelle-Northwest developed techniques and equipment for characterizing the radioactive wastes stored in tanks on the Hanford Reservation, for performing in situ tests of waste tank contents, and for sealing perforated wells with an asphaltic emulsion. The equipment and sampling methods developed were shown to be effective for the wide variety of waste materials stored in the Hanford waste tanks. (auth)

24716 (LA-UR-75-876) RELEVANCE OF NUCLIDE MIGRATION AT OKLO TO THE PROBLEM OF GEOLOGIC STORAGE OF RADIOACTIVE WASTE. Walton, R. D.; Cowan, G. A. Jun 1975. Contract W-7405-ENG-36. 11p. (CONF-750641-1; SM-204/1). Dep. NTIS $4.00.

From IAEA International symposium on the OKLO phenomenon; Libreville, Gabon (23 Jun 1975).

Analyses of Oklo samples published by French scientists and the data presented by U. S. scientists at this symposium indicate that escape of radioactive products from the Oklo reactor zones was quite limited. Apparently, the major radioactive products that might have been measured in the surrounding environment at the time of the reaction would have been due to ^{85}Kr and, possibly, ^{137}Cs and ^{90}Sr. Other fission product elements which have been significantly displaced over the intervening epochs include Xe, Rb, Ba, Mo, and I. The heavy elements have remained relatively fixed. These conclusions must remain tentative until additional analyses are completed on samples taken near the interfaces between reactor and non-reactor zones. Relevance of these tentative conclusions to other geologic formations must await further study of comparative geochemistry and geology. (auth)

24717 (SAND-74-5855) NUCLEAR WASTES BENEATH THE DEEP SEA FLOOR. Bishop, W. P.; Hollister, C. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 19p. (CONF-750830-1). Dep. NTIS $4.00.

From 5th international ocean development conference; Tokyo, Japan (3 Aug 1975).

Projections of energy demands for the year 2000 show that nuclear power will likely be one of our energy sources. But the benefits of nuclear power must be balanced against the drawbacks of its by-product: high-level wastes. While it may become possible to completely destroy or eliminate these wastes, it is at least equally possible that we may have to dispose of them on earth in such a way as to assure their isolation from man for pe-

riods of the order of a million years. Undersea regions in the middle of tectonic plates and in the approximate center of major current gyres offer some conceptual promise for waste disposal because of their geologic stability and comparatively low organic productivity. The advantages of this concept and the types of detailed information needed for its accurate assessment are discussed. The technical feasibility of permanent disposal beneath the deep sea floor cannot be accurately assessed with present knowledge, and there is a need for a thorough study of the types and rates of processes that affect this part of the earth's surface. Basic oceanographic research aimed at understanding these processes is yielding answers that apply to this societal need. (auth)

24718 INTERIM STORAGE OF SOLIDIFIED HIGH-LEVEL RADIOACTIVE WASTES. Contract AT(11-1)-3053. Washington, DC; National Academy of Sciences (1975). 89p. $8.50.

This report responds to a request by the U. S. Atomic Energy Commission, dated November 7, 1972, to the Committee on Radioactive Waste Management (CRWM) of the National Academy of Sciences–National Research Council, for advice "concerning the AEC's concepts for the safe storage of high-level solidified waste for an interim period in an engineered storage facility at or near the surface of the earth." The Panel on Engineered Storage of the Committee on Radioactive Waste Management has reviewed the three most promising of AEC's concepts--specifically, those based on solidified waste and involving storage in a water basin, an air-cooled vault, or a sealed storage cask. It is concluded that any of these concepts could lead to storing solidified high-level radioactive wastes generated by nuclear power reactors safely and economically. However, the sealed storage-cask concept, with its passive cooling system and multiple barriers against dispersal of waste, appears to offer substantial advantages. A sealed storage-cask facility can be designed and constructed to provide the necessary safety and reliability, with a minimum of operating attention. In addition to the critical review of the three retrievable surface-storage concepts mentioned, consideration is given to the relationship of such storage to ultimate disposal, to the segregation of transuranics, to considerations of safety and environmental integrity, to determination of optimum materials for construction, to container integrity, and to anticipated costs. (auth)

Transportation

24719 (ORNL-TM-4986) LMFBR SPENT FUEL TRANSPORT: EFFECTS OF USE OF DOWTHERM AS CASK COOLANT. Irvine, A. R. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 23p. AT.

The effects of use of Dowtherm as a cask coolant on facilities at the reactor and reprocessing sites and on safety of spent fuel shipment are examined. Significant disadvantages in the use of Dowtherm were found at each of the areas; however, an engineering solution is available to accommodate each negative effect. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 24924.

24720 (LBL-3618) DESIGNING WITH COMPUTERS AT LAWRENCE BERKELEY LABORATORY. Colonas, J. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1974. Contract W-7405-ENG-48. 8p. (CONF-741001-60). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

The application of digital computers to the solution of engineering problems relating to accelerator design was explored. The existing computer hardware and software available for direct communication between the engineer and the computer are described, and some examples of useful programs are outlined, showing the ease of their use and the method of communication between machine and designer. An effort is made to convince engineers that they can communicate with the computer in ordinary english and mathematics, rather than in intermediate artificial languages. (auth)

24721 (LBL-4085) 150 MeV PROTON MEDICAL CYCLOTRON DESIGN STUDY. Burleigh, R. J.; Clark, D. J.; Flood, W. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1975. Contract W-7405-ENG-48. 6p. (CONF-750824-7) Dep. NTIS $4.00

From seventh international conference on cyclotrons and their applications; Zurich, Switzerland (19 Aug 1975).

A brief design study was done for a 150 MeV proton sector cyclotron. The object was to minimize cost while maintaining reliability and easy maintenance. The use of the proton beam would be for therapy, radiography, and isotope production. (auth)

24722 (LBL-4086) HEAVY ION BOOSTER CYCLOTRON DESIGN STUDIES AT BERKELEY. Burleigh, R. J.; Clark, D. J.; Glasgow, L. R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1975. Contract W-7405-ENG-48. 6p. (CONF-750824-6). Dep. NTIS $4.00.

From seventh international conference on cyclotrons and their applications; Zurich, Switzerland (19 Aug 1975).

Design studies on four booster cyclotrons for heavy ions are described. Comparisons are made of normal vs. superconducting main coils and of K equals 400 and 800 sizes. Performance and cost estimates are given. (auth)

24723 MEDICAL PROTONIC TRACT OF SYNCHROCYCLOTRON OF THE LENINGRAD INSTITUTE OF NUCLEAR PHYSICS. Karlin, D. L.; Konnov, B. A.; Vinogradov, B. V.; Nizkovolos, V. B.; Kuzenetsov, E. A. (Central Scientific-Research Rentgeno-Radiological Inst., Leningrad). Med. Radiol.; 20: No. 7, 13-19(Jul 1975). (In Russian).

The synchrocyclotron with an energy of 1 GeV was used at the Leningrad Institute of Nuclear Physics to create a medical protonic tract and develop a method of forming narrow proton beams for conducting medico-biological investigations. (auth)

24724 CALCULATION OF PARAMETERS AND SOME PHYSICAL CHARACTERISTICS OF LEVELLING FILTERS FOR BETATRON ELECTRON BEAM. Shishov, V. A. (Scientific-Research Inst. of Oncology, Moscow). Med. Radiol.; 20: No. 7, 66-73(Jul 1975). (In Russian).

A method is described for calculating the optimal parameters of scattering foils and compensators for the electron beam of the betatron. A comparative assessment of two methods of forming was conducted, using a single scattering foil and using a scattering foil in combination with a compensator. The use of compensators increases by several times the dose rate of the formed irradiation within the given uniformity of the dose fields. In addition, the loss of energy and the bremsstrahlung background which develop in the foils considerably decrease. The isodose curves taken in the tissue equivalent phantom are given. (auth)

24725 FORMATION OF IRRADIATION FIELDS WITH ELECTRON BEAM OF A LINEAR ACCELERATOR LUE-25. Bazhanov, E. B.; Zabrodin, B. V.; Kozlov, A. P.; Ol'kov, M. S.; Belov, V. P.; Prudnikov, I. A.; Shvedchikov, I. P. (Inst. of Oncology, Moscow). Med. Radiol.; 20: No. 7, 59-66(Jul 1975). (In Russian).

Some constructive peculiarities of radiation fields created by a beam of fast electrons are considered. The use of stationary magnetic fields and a thin diaphragm at the output form the basis of the system. A dosimetric study of the main characteristics of the formation system in tissue equivalent media was made. (auth)

Auxiliaries and Components

24726 (CONF-750710-1) METHOD FOR MEASUREMENT OF THERMAL CONDUCTANCE. Kuchnir, M. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). [nd]. 14p. Dep. NTIS $4.00.

From international cryogenics materials conference; Ontario, Canada (Jul 1975).

A simple and elegant method for determining the heat losses of strong insulating supports operating between 4.2 K and 300 K with a 20 K intercept was developed. The method does not involve boil-off measurements, and distinguishes heat losses due to conduction from those due to infrared radiation. The method was developed for determining the heat losses of the supports for the 20 foot long, 45 kG, warm iron superconducting magnets planned for the Energy Doubler stage of the Fermilab accelerator. (WHK)

24727 (INIS-mf-1717) TRIUMF ANNUAL REPORT, 1973. (British Columbia Univ., Vancouver (Canada)). Nov 1974. 64p. INIS.

Progress on the construction of the TRIUMF cyclotron for 1973 is reported. The major problem encountered was reduction of the errors in the field of the as-built magnet to tolerable levels. The central region cyclotron was able to accelerate 100 μA of H^- ions to the full maximum energy of 3 MeV, and the main cyclotron ion source achieved production of 100 μA at 300 keV. (INIS)

24728 SECONDARY EMISSION METERS FOR THE CURRENT STRENGTH OF A BEAM OF ACCELERATED ELECTRONS. Prudnikov, I. A. Meas. Tech. (USSR) (Engl. Transl.); 17: No. 9, 1452-1454(Sep 1974).

Translated from Izmer. Tekh.; 17: No. 9, 85-87(Sep 1974).

Results are presented of experimental and theoretical investigations of the applicability of electron secondary-emission meters to accelerator electron beam monitoring. The following characteristics indicate their suitability: (1) structural simplicity; (2) small dimensions; (3) good reliability; (4) measurements may be taken over a wide range of current densities and pulse shapes; (5) high output signal; and (6) insignificant effect on beam parameters. (PMA)

24729 LARGE HELIUM SYSTEMS FOR SUPERCONDUCTING POWER APPLICATIONS AND HIGH ENERGY PHYSICS. Jensen, J. E. (Brookhaven National Lab., Upton, NY). pp 90-105 of Applications of Cryogenic Technology. Vol. V. Carr, R. H. (ed.). Whitestone, NY; Scholium International, Inc. (1973).

From 5th annual conference of the Cryogenic Society of America; Chicago, Illinois, USA (3 Oct 1972). See CONF-721023-.

The emergence of superconductivity, from the laboratory, as a practical means of transporting large electrical currents promises to have a profound effect on liquid helium temperature refrigeration systems. Some of these systems will require the distribution of the refrigeration over tens of kilometers of length while others will require tens of kilowatts of refrigeration in relatively small areas. Examples of such systems are described, bringing out some of the heat transfer and hydrodynamic requirements. The effects of the transport properties of helium on the system requirements in several pressure-temperature regions are presented. Estimates of the quantity of helium required are included. (auth)

24730 CRYOPUMPING A LARGE ACCELERATOR. Tanabe, J. T.; Byrns, R. A. (Univ. of California, Berkeley). pp 244-262 of Applications of Cryogenic Technology. Vol. V. Carr, R. H. (ed.). Whitestone, NY; Scholium International, Inc. (1973).

From 5th annual conference of the Cryogenic Society of America; Chicago, Illinois, USA (3 Oct 1972). See CONF-721023-.

A cryogenic vacuum pump, designed to lower the base pressure from 2×10^{-6} torr to 3×10^{-7} torr, was installed in the Bevatron in February 1972. The Bevatron, a particle accelerator at the Lawrence Berkeley Laboratory, contains approximately 11,000 ft^3 of free volume and an excess of 100,000 ft^2 of outgassing surfaces pumped by 24 freon-baffled 32-inch oil diffusion pumps. The gas loads consist of metallic and organic outgassing surfaces as well as air leaks from nonrepairable radiation-hardened aged gaskets and mechanical actuators. Nine cryopanels, fed by 20 K recirculating helium refrigerators and 80 K boiling liquid nitrogen, were installed. Monte Carlo computations predict noncondensable (at 77 K) pumping speed of 140,000 liters/sec and a condensable pumping speed of greater than 500,000 liters/sec. Final measurements are included. (auth)

24731 GENERAL-PURPOSE HIGH-SPEED PUMPING SYSTEM SUITABLE FOR PRESSURIZED ACCELERATOR OPERATION. McEver, W. S.; Volkers, J. C.; Donoghue, T. R. (Ohio

State Univ., Columbus (USA). Dept. of Physics). Nucl. Instrum. Methods; 126: No. 2, 157-163(1 Jun 1975).

A high-speed pumping system consisting of a rod-type titanium sublimator together with an integral ion pump is described. This system has many attractive features for general laboratory use, but was found to be particularly well-suited for operation in the high-voltage terminal of a pressurized Van de Graaff accelerator. Pumping speeds of approximately 2200 l/s for hydrogen (H_2) at 10^{-6} torr are attained; additionally, under light gas loads, ultimate vacuums of approximately 10^{-8} torr are attained. The system is inexpensive to construct in any machine shop and to maintain. Total power consumption of the pump system is < 400 W. (auth)

24732 TEST OF HEAVY-ION GAS-FOIL STRIPPING FOR IMPROVED FOIL LIFETIME IN TANDEM VAN DE GRAAFF ACCELERATORS. Thieberger, P.; Wegner, H. E. (Brookhaven National Lab., Upton, N. Y. (USA)). Nucl. Instrum. Methods; 126: No. 2, 231-233(1 Jun 1975).

A heavy-ion stripping arrangement, consisting of gas stripping in the high-voltage terminal and foil stripping at the ¾V/sub t/ point, was successfully tested at the Brookhaven Tandem Van de Graaff facility. For a NiO^- beam, the foil lifetime at the second stripper was about 30 times longer than that observed for a foil stripper at the high-voltage terminal receiving the same beam current. This effect is attributed to larger beam energy and lower beam density at the second stripper location. Charge-state distributions obtained with this arrangement are shown in terms of an intensity-versus-energy diagram and are compared to similar curves for single-foil, dual-foil, and single gas strippers. (auth)

Ion Sources and Injection and Extraction Systems

24733 A 30 PER CENT BEAM EXTRACTION ON THE 1 GeV SYNCHROCYCLOTRON AT GATCHINA. Abrosimov, N. K.; Volchenkov, V. A.; Eliseev, V. A.; Riabov, G. A.; Chernov, N. N. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki). Nucl. Instrum. Methods; 126: No. 2, 221-230(1 Jun 1975).

The mechanism and efficiency of the non-linear regenerative extraction system for synchrocyclotrons were analyzed. Low efficiency of such systems is connected with the instability of vertical motion $\nu_z = 0$ and $\nu_z = 0.5$, large-effective width of the iron magnetic-channel septum, and inadequate acceptance of the channel and regenerator. A wide-aperture extraction system for the 1 GeV synchrocyclotron, based on this analysis, increases the extraction efficiency, and the distinguishing features of the system are described. The extraction efficiency is about 30%, and a good agreement was obtained between the theoretical and experimental beam parameters. (auth)

Ion Optics and Field Calculations

24734 (JINR-P9-8752) LONGITUDINAL STABILITY OF CHARGED BEAM IN A PERIODICAL SYSTEM METAL-INSULATOR. Reshetnikova, K. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 19p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Longitudinal stability of a magnetized electron beam in a periodical structure metal-insulator has been considered in a linear approximation. It is shown that the beam is stable with respect to the long-wave perturbations and can be unstable with respect to perturbations for which the wavelength in the insulator is comparable or shorter than the structure period. (auth)

24735 (JINR-P11-8780) STUDY OF NONLINEAR RESONANCE ($2\nu_z - \nu_x = 1$) OF THE THIRD ORDER FOR JINR SYNCHROPHASOTRON USING KRYLOV-BOGOLUBOV METHOD. Amirkhanov, I. V.; Vasilev, V. K.; Zhidkov, E. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 19p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The third order resonance ($2\nu_z - \nu_x = 1$), which occurs near the working point of the JINR synchrophasotron, was studied. Truncated equations were found by the method of averaging, and a complete study of these equations was carried out. (auth)

24736 (UCID-16886) GEOMETRIC CORRECTION TO THE ENERGY CHANGE OF A PARTICLE TRAVERSING AN RF GAP. Neil, V. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Aug 1975. Contract W-7405-Eng-48. 9p. Dep. NTIS $4.00.

The expression for the change in energy of a charged particle moving across the gap region of an rf cavity is derived, taking into account corrections for: (1) the finite time taken by the particle to cross the gap; and (2) the dependence of the energy change on the radius of the particle trajectory as it traverses the gap. Although the expression is well known to accelerator scientists and engineers, its derivation seems to have been lost in antiquity, so it is derived with considerable mathematical rigor. The equation is then applied to the 500 MHz modulating gap in the beam line from the Astron accelerator, with the result that the geometric corrections to the energy change are not significant. (PMA)

24737 MEDICAL π-MESONIC BEAM OF THE NUCLEAR PROBLEMS LABORATORY, UNITED INSTITUTE OF NUCLEAR INVESTIGATIONS. Dzhelepov, V. P.; Savchenko, O. V.; Abazov, V. M.; Kuz'min, E. S.; Molokanov, A. G.; Reshetnikov, G. P.; Cherevatenko, E. P.; Ruderman, A. I.; Astrakhan, A. V.; Vainberg, M. Sh.; Makarova, G. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Med. Radiol.; 20: No. 7, 3-13(Jul 1975). (In Russian).

A method is described for obtaining an intensive beam of π^-mesons using a wide-angle solenoid lens with a heterogenous axial-symmetrical magnetic field. For mesons with an energy of about one MeV, with protons of 670 MeV and intensity of $\sim 10^{12}$ c^{-1} falling on the copper target, the following parameters of the beam were obtained: complete intensity $\sim 10^7$ s^{-1}, density of the flow $\sim 10^5$ $cm^{-2}s^{-1}$, density of stops 5×10^{14} $g^{-1}s^{-1}$ in the water. For the beam of π^+ mesons, these parameters were 3½ to 4 times greater. The dose rate in the Bragg peak for the beam of π^- mesons was about 3 rad/min. The beam of π^- mesons is intended for radiobiological and some clinical investigations into radiation therapy of patients with tumours. (auth)

24738 APPLICATION OF BUCH'S THEOREM TO MAGNETIC LENSES FOR BEAM FOCUSSING. Dalglish, R. L.; Kelly, J. C. (New South Wales Univ., Kensington (Australia). School of Physics). Phys. Lett., A; 53: No. 3, 249-250(16 Jun 1975).

It is shown that the generalisation of Busch's theorem used in the analysis of magnetic lens systems for imaging in microscopes, can lead to a false prediction of the quality of focus forming systems used for probes. (auth)

Storage Rings

Refer also to abstract 24931.

Experimental Facilities

Refer also to abstracts 24163, 24395, 24403, and 24435.

24739 PRODUCTION OF LAWSONITE FILM LIQUID HYDROGEN TARGETS. Vasil'ev, L. M.; Dmitrevskii, Yu. P.; Mel'nik, Yu. M. (Inst. of High Energy Physics, Serpukhov, USSR). Cryogenics; 13: No. 3, 180-181(Mar 1973).

A method is described for making Mylar containers for liquid hydrogen targets to be used in high energy experiments at the IFVE accelerator. The containers were tested for strength at a pressure of 2 atm, after which the strength of the joints in vacuum was examined at both room temperature and at liquid nitrogen temperatures. (PMA)

24740 CRYOPUMPED HYDROGEN JET TARGET. Bartenev, V. (Inst. of High Energy Physics, Serpukov, USSR); Klen, J.; Kuznetsov, A.; Malamud, E.; Morozov, B.; Nikitin, V.; Pilipenko, Y.; Popov, V.; Strauss, B.; Sutter, D.; Zolin, L. pp 263-268 of Applications of Cryogenic Technology. Vol. V. Carr, R. H. (ed.). Whitestone, NY; Scholium International, Inc. (1973).

From 5th annual conference of the Cryogenic Society of America; Chicago, Illinois, USA (3 Oct 1972). See CONF-721023-.

The hydrogen jet target, a product of joint USSR-USA research, replaces conventional foil targets for proton-proton interactions in the main accelerator of the National Accelerator Laboratory. Cryogenic systems are necessary both to prepare the jet target and to maintain the accelerator vacuum against the introduction of hydrogen gas pulses. (auth)

24741 MAGNETIZED FOCUSING IRON SHIELD AGAINST MUONS IN HIGH-ENERGY NEUTRINO BEAMS. Hartmann, R. (Bonn Univ. (F. R. Germany). Physikalisches Inst.); Leutz, H. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 126: No. 2, 165-174(1 Jun 1975).

A magnetized iron shield is proposed for the removal of muons from a neutrino beam produced by pion and kaon decay. The magnetizing axial current produces magnetic field lines concentric to the beam axis and causes the muons (positive for neutrino- or negative for antineutrino beams) to oscillate. The amplitude of these transverse oscillations decreases according to the energy loss of the muons, and the muons are finally concentrated near the beam axis. The shield diameter decreases towards the neutrino detector instead of being increased (due to multiple muon scattering) as with a conventional shield. Oppositely charged muons are fanned out. The muon trajectories were computed using the muon intensity and energy distribution from a 150 GeV proton beam, a 150 m decay tunnel with 1.2 m dia resulting, and three focusing

devices for the pions. Multiple scattering and large-angle scattering were taken into account. The results prove that the magnetized shield requires only about 21% of the iron which would be necessary to achieve the same shielding effect with a passive iron shield. The separation of oppositely charged muons provides the possibility of measuring both components and determining the $\bar{\nu}(\nu)$ background in $\nu(\bar{\nu})$ beams. (auth)

24742 PARTICLE TRAJECTORIES IN A CYLINDRICAL CONDENSER CALCULATED IN A THIRD-ORDER APPROXIMATION. Matsuo, T. (Giessen Univ. (F. R. Germany). 2. Physikalisches Inst.). Nucl. Instrum. Methods; 126: No. 2, 273-279(1 Jun 1975).

The radial ion trajectories in a cylindrical condenser (used e.g., in mass spectrometers or energy analyzers) are calculated in a third-order approximation and presented in the form of a transfer matrix. (auth)

24743 PRODUCTION OF DT NEUTRONS BY MEANS OF TiT TARGETS AND ANALYZED ATOMIC DEUTERON BEAMS. Stengl, G.; Vonach, H. (Oesterreichische Akademie der Wissenschaften, Vienna. Inst. fuer Radiumforschung und Kernphysik); Fabian, H. (NUKEM, Hanau, F. R. Germany). Nucl. Instrum. Methods; 126: No. 2, 235-239(1 Jun 1975).

The behavior of TiT targets during irradiation with a pure beam of atomic deuteron ions was investigated. The time dependence of the absolute DT neutron yield and the build-up of DD neutron intensity was determined at a constant current density of 0.3 mA/cm^2 for both a 2 Ci and 5 Ci/in.^{2} TiT target. Half-lives of 12 mAh/cm^2 and 18 mAh/cm^2 for the DT neutron yield were observed in these two cases. These half-lives are more than an order of magnitude longer than those observed using TiT targets in low-energy accelerators with unanalyzed beams. The DD neutron intensity rises approximately proportionally with the irradiation time and reaches a saturation value of about 0.3% of the initial DT yield or 30% of the yield of a TiD target at the end of one half-life. The results suggest that the effect of replacement of tritium by the implanted deuteron is less than hitherto assumed and most of the deuterons are capable of diffusing out of the target without interaction with the tritium. It appears that the short half-lives observed with the use of unanalyzed beams are mainly due to sputtering and radiation damage caused by heavy-ion contaminants always present in unanalysed beams. (auth)

24744 UNIVERSAL TARGET MANIPULATOR FOR USE IN ULTRA-HIGH VACUUM. Turkenburg, W. C.; de Haas, E.; Neuteboom, A. F.; Ladru, J.; Kersten, H. H. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). Nucl. Instrum. Methods; 126: No. 2, 241-245(1 Jun 1975).

A target manipulator for use in ultra-high vacuum rotates a sample around three different axes with high accuracy using computer-controlled stepping motors. The manipulator also allows a horizontal and a vertical translation. The sample can be cooled to −150°C and heated up to 500°C, and the system is bakeable up to 150°C. (auth)

24745 PULSATION-REGROUPING IN THE NS DOMAIN. I. Pulsation by Impulses. Noblet, A. (Brussels Univ. (Belgium)). Nucl. Instrum. Methods; 125: No. 3, 471-478(15 Apr 1975). (In French).

In this paper the theoretical expressions which permit the determination of the characteristic parameters of a pulsing device driven by voltage pulses are established. Different cases are distinguished according to the relative duration of the pulses being longer or shorter than the particle transit time. Next the realization of such a pulser is described and the experimental results permitting a conclusion on the validity of the expressions previously quoted are given. (auth)

24746 PULSATION-REGROUPING IN THE NANOSECOND DOMAIN. II. Regrouping by Speed Modulation. Noblet, A. (Brussels Univ. (Belgium)). Nucl. Instrum. Methods; 125: No. 3, 479-485(15 Apr 1975). (In French).

After having briefly recalled the conclusions of a theoretical study previously published, the realization of a four-gap buncher is described. This device is fed by a pulser which is itself driven by pulses so that it is necessary to set a synchronization between the buncher and the pulser signals. The fwhh of the target pulse, after bunching, is of the order of one ns. The measurements made on the assembly have allowed the accuracy of the theoretical results to be checked. (auth)

24747 COMPUTER-CONTROLLED TARGET-POSITIONING SYSTEM. Brendle, M.; Steidle, G. (Tuebingen Univ. (F. R. Germany). Physikalisches Inst.). Nucl. Instrum. Methods; 126: No. 1, 93-98(15 May 1975).

Different targets are positioned in front of a counter telescope by a stepmotor. A light barrier or a reed switch defines a reference position. Up to eight positioners are controlled by an on-line computer by means of a multiplex switch. (auth)

24748 COMPUTATIONAL TECHNIQUE FOR TUNING THE LAMPF HIGH-ENERGY PION CHANNEL. Hudomalj, J. (Houston Univ., Tex. (USA)); Mann, D.; Gabitzsch, N. D. (Rice Univ., Houston, Tex. (USA). Bonner Nuclear Labs.); Bordner, C. (Colorado College, Colorado Springs, Colorado 80903, USA); Macek, R. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 126: No. 1, 1-5(15 May 1975).

A computational technique used in tuning the LAMPF high-energy pion channel is described. In the tune-up procedure the trajectories of individual particles are measured using multiwire proportional counters interfaced to a PDP-11/20 computer. Constraints upon the beam parameters are imposed in a form of error functions representing the deviation of the measured parameters from the ones calculated by the beam design code TRANSPORT. A search is carried out on-line to minimize the error functions and find the optimum quadrupole magnet currents. (auth)

24749 TUNE-UP OF THE LAMPF HIGH-ENERGY PION CHANNEL. Gabitzsch, N. D.; Manm, D.; Pfeufer, G.; Phillips, G. C. (Rice Univ., Houston, Tex. (USA). Bonner Nuclear Labs.); Hudomalj, J.; Lee, L. Y.; Warneke, M.; Allred, J. C. (Houston Univ., Tex. (USA)); Macek, R. J.; Werbeck, R. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 126: No. 1, 7-12(15 May 1975).

The LAMPF high-energy pion channel was tuned by tracing individual particles through the channel using multiwire proportional counters. Beam spot sizes, divergences, dispersions, and correlations between angle, displacement, and momentum were measured and optimized in an on-line least-squares search. The results are compared to predictions made by the TRANSPORT computer code, and it is found that the experimental results are in agreement with computer calculations. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

24750 RADIO AND OPTICAL ASTROMETRY. Wade, C. M. (National Radio Astronomy Observatory, Green Bank, W. Va. (USA)). pp 133-139 of New Problems in Astrometry. Gliese, W.; Murray, C. A.; Tucker, R. H. (eds.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on new problems in astrometry; Perth, Australia (13 Aug 1973).

Radio positional measurements have achieved an accuracy as high as that of optical astrometry, with uncertainties no greater than a few hundredths of an arc second in each coordinate. Declinations and relative right ascensions are determined absolutely. Since the principal sources of systematic error are different for radio and optical astrometry, radio measurements can be useful in the preparation of future fundamental catalogues. (auth)

24751 SOME FILTER TECHNIQUES IN THE FAR INFRARED. Wijnbergen, J. J. (Katpteyn Sterrewacht, Roden, The Netherlands). Space Sci. Rev.; 17: No. 5, 657-658(Jul 1975).

For astronomical observations outside the atmosphere, infrared photometers are used, which are launched with telescopes on balloon platforms. The radiation is detected by helium cooled bolometers and the spectral band is selected by the application of the reststrahlen reflection of halogenide crystals in the same cryostat. At the low temperatures the most favourable characteristics of this reflection are an excellent spectral reproducibility because of the use of well defined materials, a steep short wavelength edge and a high reflectivity in the reststrahlen band. This last property permits the application of multiple reflection filters. With four crystals in series, a resolution is obtained of $\lambda/\Delta\lambda = 2\text{-}5$ at an effective reflection of roughly 70%. The filter technique covers the infrared region from 20 to 200 μm. (auth)

Cosmic Radiation

Refer also to abstracts 24827 and 24949.

24752 (LA-UR-75-985) OBSERVATIONS OF COSMIC GAMMA-RAY BURSTS. Klebesadel, B.; Strong, I. B. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 20p. (CONF-750639-1). Dep. NTIS $4.00.

From 18th plenary COSPAR symposium on fast transients in X- and gamma rays; Varna, Bulgaria (29 May 1975).

The occasional occurrence of brief but intense bursts of cosmic gamma-rays was disclosed through a systematic search of data acquired from the Vela satellites. Confirmation of the nature of the events and additional detail of their characteristics has subsequently been provided by 15 other groups of experimenters with instruments on 13 spacecraft. Thirty-nine such events have been identified from data spanning a period of four and one-half years. The record of intensity as a function of time varies considerably for different events, with total durations ranging from 0.1 to approximately 60 s. Time integrated flux density ranges from approximately 10^{-6} to 10^{-3} erg cm^{-2}. Spectral measurements have been accomplished by several groups of experimenters, showing a broad maximum in the energy distribution at about 150 keV. The distribution of source directions, implies either near galactic or extragalactic locations. The existing data are not sufficient to distinguish between the various models proposed to explain the phenomenon; however, it appears that no model is completely consistent with all observed characteristics. (auth)

24753 (UH-511-162-73, pp 56-59) COSMIC-RAY MUON CHARGE RATIO MEASUREMENT AND A TEST OF FEYNMAN SCALING. Maung, T. (Univ. of California, San Diego). Sep 1973.

From fifth topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

The results of a cosmic-ray muon charge ratio measurement over an energy range of 100 GeV to 1.5 TeV are reported, and the data are compared with the prediction of the Feynman scaling hypothesis. (JFP)

24754 COHERENT SCATTERING OF COSMIC NEUTRINOS. Opher, R. (Israel Inst. of Tech., Haifa). Astron. Astrophys.; 37: No. 1, 135-137(Dec 1974).

It is shown that cosmic neutrino scattering can be non-negligible when coherence effects previously neglected are taken into account. The coherent neutrino scattering cross section is derived and the neutrino index of refraction evaluated. As an example of coherent neutrino scattering, a detector using critical reflection is described which in principle can detect the low energy cosmic neutrino background allowed by the measured cosmological red shift. (IAA)

24755 INTRODUCTORY COSMIC RAYS. Wolfendale, A. W. (Durham Univ. (UK)). pp 1-12 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974). 13 refs.

Despite the identification of the particles present in the cosmic ray beam and a host of measurements on the energy spectra of the components and of the manner in which the particles propagate through the atmosphere and below ground the origin of the bulk of the primary particles is still unclear. Only at "low" energies, below about a GeV, has it been possible to identify the sun as a source of some of the particles. The origin of those components, largely of higher energy and coming from more distant sources, is considered. (auth)

24756 GALACTIC PROPAGATION OF COSMIC RAYS BELOW 10^{14} eV. Osborne, J. L. (Durham Univ. (UK)). pp 203-220 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974).

The question of whether the observed anisotropy and lifetime of cosmic rays can be reconciled with the hypothesis of galactic origin in discrete sources such as supernovae or supernova remnants is discussed. The propagation of the electron component of the cosmic ray flux is discussed in the article by Meyer. Here only the nuclear component is considered. In the energy region above 10^{14} eV the energy density of the cosmic rays and the pressure exerted by them are so low that they must have a negligible effect on the magnetic fields through which they propagate. At the lower energies considered here, the mutual interaction between the particles and the field has to be taken into account. (auth)

24757 GALACTIC STRUCTURE, MAGNETIC FIELDS, AND COSMIC RAY CONTAINMENT. Thielheim, K. O. (Kiel Univ. (F. R. Germany). Inst. fuer Reine und Angewandte Kernphysik). pp 165-201 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974).

Cosmic ray research has become predominantly a branch of astrophysics. Under this aspect, the origin and transfer of cosmic ray particles through interstellar space are the objects of main interest. In trying to understand these phenomena, one soon is lead to the conclusion that the structure and dynamics of cosmic magnetic fields have to be studied in advance. Specifically the structure of the galactic fields has to be known. In working on the structure of magnetic fields one eventually finds out that it is necessary to have basic information on the other constituents of the galaxy as well. This is due to the fact that the magnetic fields are coupled to the interstellar plasma which in turn through gravitational forces is linked to the distribution of stellar matter. (auth)

24758 NUCLEOSYNTHESIS AND GALACTIC COSMIC RAYS. Reeves, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). pp 135-164 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974).

The interaction between Nucleosynthesis and Galactic Cosmic Rays is discussed, the aim being twofold. Firstly: what is the nucleosynthesis that results from Galactic Cosmic Rays (G. C. R.). Secondly: from the nucleosynthesis, or more exactly, from a determination of the real abundances of the elements accelerated to be cosmic rays, can something be said about the origin of the G. C. R. (auth)

24759 NUCLEAR MASS COMPOSITION AT "LOW" ENERGIES (i.e. < 10^{12} eV/NUCLEON). Rasmussen, I. L. (Danish Space Research Inst., Lyngby). pp 97-133 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974). 45 refs.

The fully ionized atomic nuclei of all the elements from hydrogen up to at least uranium, which constitute the nuclear component of the galactic cosmic radiation, are the only sample of

matter which reach the earth from outside the solar system. It is believed that these nuclei were created in the nuclear burning processes that take place inside stars during their evolution, and that the composition of the nuclear cosmic rays is one of the most important sources of information about the nucleosynthesis in the stars and the composition of matter in important regions of the galaxy. Studies of the cosmic ray charge composition during the last 25 years have shown that between the time of creation deep inside a star and the time of detection here in the solar system, the cosmic rays have gone through many processes in widely different environments. After they are created they must be moved out of the star, accelerated to high energies and propagated through interstellar space. Each of these processes change the composition of the cosmic rays and a study of this composition will, therefore, yield information on all these processes. A knowledge of the charge composition is not sufficient to allow the cosmic rays to be traced back to the source and learn what the source composition of the cosmic rays was. In order to do this, and thereby obtain information on what and where the cosmic ray sources are, the isotopic composition of the cosmic rays must also be known. In this paper a review is given of present and proposed methods for the measurement of the masses of cosmic rays and some of the results already obtained are discussed. (auth)

24760 ENERGY SPECTRA AND MASS COMPOSITION OF COSMIC RAY NUCLEI FROM 10^{12} TO 10^{20} Ev. Watson, A. A. (Leeds Univ. (UK). Dept. of Physics). pp 61-95 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974). 92 refs.

A view of the cosmic ray energy spectrum above 10^{12} eV which has been popular during the last ten years is one in which the spectral index above 10^{12} eV changes fairly sharply every 3 decades in energy. Between 10^{12} and 10^{15} eV the primary intensity was believed to fall with an integral exponent of -1.6; from 10^{15} to 10^{18} eV the fall became significantly steeper (exponent = -2.2) but above 10^{18} eV the earlier, gentler, slope was resumed. It was often held that the steepening above 10^{15} eV was associated with an enrichment of heavy nuclei in the cosmic ray beam consequent upon the onset of leakage of protons from the galaxy, while the feature at 10^{18} eV has been associated with the appearance of extragalactic particles, probably protons, as the dominant component in the primary flux. Evidence is accumulating which suggests the need for a revision of this picture. At the lower energies (10^{12} to 10^{15} eV) the prospects of identifying specific astronomical objects, for example pulsars, as the sources of cosmic rays have been heightened by claims that there are differences between the spectral indices of different nuclei at energies of about 10^{15} eV/nucleon, and near 10^{15} eV the details of the spectral break have begun to appear rather complex. At greater energies a major question is whether or not the cosmic rays are extragalactic; the flattening of the spectrum above 10^{18} eV has been seriously questioned and at the highest energies ($> 5.10^{19}$ eV) attention is focussed on the problem of seeking spectral features which may have cosmological interest. (auth)

24761 SIDEREAL DAILY VARIATIONS IN COSMIC RAY INTENSITY AND THEIR RELATIONSHIPS TO SOLAR MODULATION AND GALACTIC ANISOTROPIES. Thambyahpillai, T. (Imperial Coll. of Science and Technology, London (UK). Dept. of Physics). pp 37-59 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974).

From the earliest days of cosmic ray intensity recording, it has been recognised that with a fixed instrument one could use the spin of the earth to scan different parts of the sky and to measure anisotropies by the diurnal periodic variations that should be induced in the data. However, significant daily variations occur in both solar and sidereal times and because of the extreme closeness of the two periodicities (365 solar days and 366 sidereal days in one earth year) one requires unbroken data spanning one complete year or preferably a series of complete years in order to separate the two periodic variations. Even then a direct setting of the data in solar or sidereal time will not result in the separation of the solar or sidereal diurnal variations unless each type of periodic variation retained a constant amplitude and phase throughout the year. This can easily be seen by examining the situation on a harmonic dial. A harmonic dial is a method of representing a sinusoidal variation by means of a vector and is a diagram in the form of a clock-dial which is graduated in 24 hours for displaying diurnal variations. A vector radiating from the centre of the dial has a length equal to the amplitude of the sine wave and points to the time of day at which maximum intensity occurs. (auth)

24762 EXTRAGALACTIC COSMIC RAYS. Burbidge, G. R. (California Univ., San Diego (USA)). pp 25-36 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1975).

A survey of the components of the extragalactic universe is given, and the various types of extragalactic non-thermal sources are discussed. Throughout the discussion, it is assumed that the Hubble constant $H_0 = 50$ kms^{-1} Mpc^{-1}. (auth)

24763 SUPERNOVAE AND THE ORIGIN OF COSMIC RAYS. I. Colgate, S. A. (New Mexico Inst. of Mining and Technology, Socorro (USA)). pp 425-445 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974).

A brief review of the history of the observation of supernovae is given. The paper is concerned with the problem of the self-consistency of the theoretical ejection from supernovae and the observed element distribution in the galaxy as well as the implied delay in the formation of a pulsar on which the offending matter is imploding. This delay has a significant bearing on the likelihood of early pulsar spin-up origin for supernovae and cosmic rays. Detailed calculations are made of the total mass and kinetic energy of the ejecta of the most energetic supernova. The origins of type I and type II supernovae are discussed. The author further discusses the mechanisms of supernova explosions and the explosion process and neutron star formation. Comments about the binding energies of matter in various forms are made. The impact of the new universal neutrino theory of Weinberg (1971), a supernova theory is discussed. (NL)

24764 SUPERNOVAE AND THE ORIGIN OF COSMIC RAYS. II. A Model of Cosmic Ray Production in Supernovae. Colgate, S. A. (New Mexico Inst. of Mining and Technology, Socorro (USA)). pp 447-466 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974).

For the origin of cosmic rays, just one type of supernovae, namely, the Type I, is emphasized that occurs in old population stars, has little or no hydrogen in the ejecta, and where the simple calculation at the beginning of Paper I indicates that an ejection velocity of something like 3×10^9 cm/sec is a minimum velocity self-consistent with a light curve. In that paper, it was pointed out that there are several models for the light curves of supernovae other than the excitation of ejected matter. These mechanisms for the production of the light curve, other than the ejection from a compact star, depend upon a relatively large mass of matter located at a relatively large radius, an extended red giant or ejected planetary nebula distribution at 10^{14} to a few $\times 10^{15}$ cm. It is emphasized again that Type I supernovae have little or no hydrogen in their spectra, and it is an extreme assumption in stellar evolution to presume that such an extended envelope had no hydrogen. The mechanism of envelope formation depends upon the opacity as a function of temperature which is peculiar to hydrogen and indeed we would not expect an optical light curve that has no hydrogen in the spectrum to be formed from a prior large radius extended envelope. It is the converse of this; namely, the presumed highly compact initial star with no hydrogen in its envelope that is presumed to be the type of supernova that gives rise to cosmic rays based upon the theory of shock propagation and shock acceleration. (auth)

24765 POSSIBLE EXPLANATIONS OF THE SPECTRAL SHAPE. Wolfendale, A. W. (Durham Univ. (UK)). pp 221-231 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974).

A satisfactory model for the origin of cosmic rays must explain the many facts which are known about these particles and quanta. The nucleonic component is considered, particularly those particles above 10^{12} eV. The form of the primary spectrum at these energies is briefly examined and the relative merits of a number of origin models are studied. (auth)

24766 COSMIC RAY ELECTRON COMPONENT. Meyer, P. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). pp 233-266 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974).

Certainty about the presence of an electron component in the primary cosmic radiations was established by 1950 through new

observations in radio astronomy. It was discovered at the time that the galaxy is emitting a continuous spectrum of radio waves over a fairly wide band that is definitely not thermal in nature. The origin of this radio emission was soon interpreted as synchrotron radiation produced by highly relativistic electrons spiralling around the magnetic fields of the galaxy. Only in the early 1960's did it become possible to directly observe these particles as they arrive at the earth. These observations were made almost simultaneously by Earl of the University of Minnesota and Vogt and Meyer of the University of Chicago. Since that time a major effort has been undertaken to accurately measure the spectrum and the flux of these particles and indeed during the past decade the electron spectrum has become known with an accuracy comparable to that of the nuclear cosmic ray components. (auth)

24767 GAMMA RAY ASTROPHYSICS. Stecker, F. W. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). pp 267-334 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974). 102 refs.

The various processes for producing cosmic gamma radiation, as well as the significant processes for absorption of cosmic gamma radiation, are discussed. An attempt is made to place these processes in their astrophysical context in the galaxy and the universe as a whole. The interpretation of the present data on cosmic gamma radiation and its implications for cosmology and cosmic ray origin is considered. (auth)

24768 COLLAPSED STARS, PULSARS, AND THE ORIGIN OF COSMIC RAYS. Pacini, F. (Consiglio Nazionale delle Ricerche, Frascati (Italy). Lab. di Astrofisica Spaziale). pp 371-397 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974).

In the last two or three decades it has become clear that the origin of cosmic rays is related to major astrophysical phenomena, such as the activity in supernovae and their remnants, pulsars and violent events in extragalactic systems. These phenomena are characterized by the presence of large amounts of non-thermal energy in the form of magnetic fields and relativistic particles. The relevance of collapsed stars and, in particular, of pulsars is presented. (auth)

24769 OBSERVATION OF CELESTIAL GAMMA RAYS. Pinkau, K. (Max-Planck-Institut fuer Physik und Astrophysik, Garching; Muenchen (F. R. Germany). Inst. fuer Extraterrestrische Physik). pp 335-370 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974).

For the last 15 years, attempts have been made to observe celestial gamma rays, but it has been possible only very recently to construct instruments that are sufficiently sensitive for the measurement of these very weak fluxes. The very large scientific interest for these observations comes from the fact that, although gamma rays originate also from interactions of electrons with particles and fields, they are both created in nuclear interactions via the decay of unstable particles and in nuclear de-excitation as line radiation. They may thus indicate places of nucleogenesis, and of intense nuclear interaction or annihilation now and in the past. Gamma rays have a very low absorption cross-section (Stecker, 1971), and may thus be detected over very large distances or at very large red-shifts. (auth)

24770 CONCERNING MERCURY IN METEORITES. Somayajulu, B. L. K. (Physical Research Lab., Ahmedabad, India). Proc. Indian Acad. Sci., Sect. A; 81: No. 3, 137-142(Mar 1975).

The mercury concentration of all analyzed meteorites (falls) shows an increasing trend with their terrestrial age. Such a trend, in view of the intense Hg pollution of the earth, warrants careful selection of well preserved and well documented specimens for analysis. (auth)

Stars

Refer also to abstracts 24235, 24785, 25008, and 25211.

24771 (AD-743955) PHOTOMETRIC AND SPECTROSCOPIC STUDIES OF NOVAE AND SUPERNOVAE. Final Report. Rosino, L. (Osservatorio Astrofisico, Asiago (Italy)). Jan 1972. 18p. NTIS $3.00.

The report gives the principal results of the spectroscopic and photographic researches on novae and supernovae carried out during the last five years at the Astrophysical Observatory of Asiago under the direction of the writer. (GRA)

24772 (N-75-11809) HELIUM EMISSION IN THE SPECTRUM OF KAPPA CANIS MAJORIS. Bahng, J. D. R.; Hendry, E. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Astronomy). 26 Aug 1974. Contract NGR-14-007-122. 6p. (NASA-CR-140657). NTIS $3.25.

Coude spectra of kappa CMa in the red region showed H alpha and He 1 lambda lambda 5876,6678 in emission. Each of the lines had two emission components, but the helium lines had no detectable absorption feature in between. While the H alpha emission peaks were separated by 160 km/sec, the helium lines were separated by 400 km/sec. A simple model is proposed to account for the behavior of these emission lines. (STAR)

24773 (N-75-11810) PHOTOELECTRIC SPECTROPHOTOMETRY OF WOLF-RAYET STARS. Bahng, J. D. R. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Astronomy). 1974. 15p. (NASA-CR-140743). NTIS $3.25.

Photoelectric spectrum scans of five southern Wolf-Rayet stars in the spectral range lambda lambda 4600-4720 were analyzed to study the variability of brightness and of emission line strengths. No variations of any kind in short time scale were found. However, in WC stars night-to-night variations of three to four percent were detected in the emission line strengths. (STAR)

24774 HISTORICAL SEARCHES FOR SUPERNOVAE. Stephenson, F. R. (Newcastle upon Tyne Univ. (UK). Dept. of Physics). pp 399-424 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974).

The object of this paper is to discuss historical records of supernovae which have appeared in the galaxy other than the well known supernovae of 1054, 1572 and 1604. (auth)

24775 COMPARISON BETWEEN STELLAR INTERFEROMETERS. van de Stadt, H. (The Astronomical Institute, Utrecht, The Netherlands). Space Sci. Rev.; 17: No. 5, 673-676(Jul 1975).

A short discussion is presented on the different methods for obtaining high spatial resolution in the measurement of stellar diameters. One of these methods is the use of a heterodyne interferometer. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 24399, 24844, and 24852.

24776 EVIDENCE FOR NON-VELOCITY REDSHIFTS--NEW EVIDENCE AND REVIEW. Arp, H. (Hale Observatories, Pasadena, Calif. (USA)). pp 199-224 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Evidence for non-velocity redshifts in quasars and galaxies is reviewed. It is shown that all current statistical tests favour the association of at least some quasars with relatively nearby galaxies. It is shown that a statistically significant number of quasars falling close to faint galaxies have intermediate redshift (between $z = 0.4$ and 1.8). This confirms the previous result that those are the intrinsically most luminous quasars and keeps open the possibility that less luminous quasars can appear projected at large distances around very nearby galaxies. It is shown that in four individual cases where quasars fall, projected, closest to bright galaxies, the galaxies show evidence of physical interaction. New evidence for perturbations of the inner isophotes of NGC 4319 by Markarian 205 and by a radio source on the opposite side is presented. Evidence for systematically higher redshifts for compact and peculiar companion galaxies is reviewed. The intrinsic redshift-morphology relation for clusters of galaxies is commented upon and the relation to Tifft's work is noted. As a summarizing diagram, the individual associations of high redshift quasars and companions are used to show an empirical continuity of observed characteristics between compactness (taken to be a measure of youth) and excess redshift. Finally some possible theoretical explanations for intrinsic redshifts are mentioned. (auth)

24777 POSITION SOLUTION OF COMPACT RADIO SOURCES USING LONG COHERENCE VLBI. Gubbay, J. S.; Legg, A. J.; Robertson, D. S. (Weapons Research Establishment, Salisbury (Australia)). pp 125-129 of New Problems in Astrometry. Gliese, W.; Murray, C. A.; Tucker, R. H. (eds.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on new problems in astrometry; Perth, Australia (13 Aug 1973).

Compact components of several radio sources were observed in the course of VLBI observations at S-band between NASA-JPL Deep Space Stations located in Australia, South Africa and California, U. S. A., during the southern summer of 1971-72. These stations were equipped with H-maser frequency standards over this period so that the fringe frequency could be determined to better than 1 mHz. The internal consistency of the position solution could be assessed for sources observed at least three times. This varied with source declination from ±0.1″ at a declination of 45° to ±2.0″ near the equator. The spread in the position solution for P0727-11, a rapid variable at the observing frequency, was also large. Positions obtained for some other sources have been used to assist in the identification of associated optical objects. (auth)

24778 POSITIONS OF EXTRAGALACTIC RADIO SOURCES FROM VERY LONG BASELINE INTERFEROMETRY. Counselman, C. C. III (Massachusetts Inst. of Tech., Cambridge (USA)). pp 119-124 of New Problems in Astrometry. Gliese, W.; Murray, C. A.; Tucker, R. H. (eds.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on new problems in astrometry; Perth, Australia (13 Aug 1973).

The positions of extragalactic radio sources have been determined by very-long-baseline interferometry with uncertainties smaller than 0.1″, and fundamental limits on the accuracy of VLBI astrometry have not yet been reached. Technical improvements within the next five years may enable positions to be determined by VLBI with uncertainties of 0.005″. (auth)

24779 THE COUNTS OF RADIO SOURCES. Longair, M. S. (Mullard Radio Astronomy Observatory, Cambridge (UK). Cavendish Lab.). pp 93-109 of Confrontation of Cosmological Theories with Observational Data. Longiar, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Cosmic radio source counts are presented for the frequencies 178, 408, 1420, 2700 and 5000 MHz. The question of the isotropy of the distribution of radio sources on the sky is discussed, and three interpretations of the source counts are given, concentrating on the evolutionary models in which it is assumed that the radio source population evolves strongly with cosmological epoch. (NL)

24780 RADIO SOURCE COUNTS AT CENTIMETER WAVELENGTHS. Pauliny-Toth, I. I. K. (Max-Planck-Institut fuer Radioastronomie, Bonn (F. R. Germany)); Kellermann, K. I. (National Radio Astronomy Observatory, Green Bank, W. Va. (USA)). pp 111-119 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Counts of radio sources at 5 GHz(6 cm wavelength) have been derived from a number of surveys including a new strong source survey. The source counts do not appear to differ markedly from an integral number-flux relation having a slope of −1.5 between 5 and 5×10^3 sources per steradian, and show a sharp drop at source densities smaller than 5 sr^{-1}. On the basis of the form of the number counts and the observed anisotropies in the distribution of sources and of their spectra, the cosmological significance of the source counts is questioned. In particular, the evidence for strong cosmic evolution appears weaker than is generally thought unless the cosmological origin of the quasar redshifts is assumed. Measurements of the radio spectra of the source suggest a dependence of the spectral curvature on flux density. (auth)

24781 OBSERVATIONAL FOUNDATIONS OF INHOMOGENEOUS UNIVERSE. Flin, P.; Machalski, J.; Maslowski, J.; Urbanik, M.; Zieba, A.; Zieba, S. (Uniwersytet Jagiellonski, Krakow (Poland)). Obserwatorium Astronomiczne). pp 121-128 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Using new observational data at optical (Jagiellonian Field) and radio (GB region) frequencies, the distributions of galaxies and radio sources are analysed. The results of the analysis show that there is a significant non-random surface distribution of galaxies irrespective of the scale of the field investigated. The observed clumpiness does not allow the introduction of discrete hierarchical structures. The distribution of galaxies shows rather a continuous hierarchical structure and for the description of the distribution of galaxies, some density indices should be used instead of imprecisely defined clusters of galaxies. In the radio domain, the distribution of radio sources in the GB region and the number-flux density relations which come from the different subregions are investigated. The results of the investigation show that the surface density of the radio sources at several flux density levels and the number-flux density relations vary from place to place in the GB region and the significance level of the observed variations is at least 1%. The most important conclusion which can be drawn from the GB data is that results obtained from the observations of a single selected region of the sky cannot be generalized to obtain information about the whole population of radio sources in a given flux density range, and in addition the region itself—even chosen at random—ought not to be considered as a typical one. (auth)

Solar Phenomena

24782 (COM-74-50642) EXPERIMENTAL, COMPREHENSIVE FLARE INDEX AND ITS DERIVATION FOR "MAJOR" FLARES, 1955–1969. Dodson, H. W.; Hedeman, E. R. (World Data Center A, Boulder, Colo. (USA). Upper Atmosphere Geophysics). Jul 1971. 31p. (UAG-14). NTIS $0.30.

An experimental comprehensive flare index has been developed at the McMath-Hulbert observatory. It is based on five components which, when taken sequentially, constitute a crude profile of the electromagnetic radiation of the flare. The components are listed in the profile in the order of increasing wavelength. The sum of the five components gives the comprehensive flare index. (auth)

24783 CHRONOLOGY OF THE NAKHLA ACHONDRITIC METEORITE. Gale, N. H.; Arden, J. W. (Oxford Univ. (UK). Dept. of Geology and Mineralogy); Hutchison, R. (British Museum, London). Earth Planet. Sci. Lett.; 26: No. 2, 195-206(Jun 1975).

A well-defined internal Rb-Sr isochron has been determined for the unbrecciated Nakhla achondrite, defining an age T = (1.24 ± 0.01) AE and an initial $^{87}Sr/^{86}Sr$ ratio of 0.70254 ± 0.00003. The excellence of fit to the isochron shows that a very thorough Sr isotopic equilibration took place at this time between all phases of the meteorite. Recent petrological observations indicate that the age most probably represents the time of an igneous crystallization event on the parent body of Nakhla. The age shows that it can no longer be assumed that major chemical and physical differentiation processes took place only in early solar system history. The Rb-Sr systematics are shown not to require late formation of the Nakhla parent body. Geochemical similarities between Nakhla and the earth are discussed. (auth)

24784 SUN IN THE FAR INFRARED AND SUB-MM REGION. de Jager, C. (The Astronomical Institute, Utrecht, The Netherlands). Space Sci. Rev.; 17: No. 5, 645-654(Jul 1975).

A review is given of the solar radiation between wavelengths of approx. 5 μm and 1 mm. The astrophysical background is discussed, and the brightness temperatures measured in the continuous spectrum in the disk center are reviewed and compared with model predictions. The observed limb darkening (or brightening) and the line spectrum are described. Considerations are given on the usefulness of infrared observations for the investigation of small structures on the Sun. (auth)

24785 EQUIVALENT WIDTH OF MOLECULAR LINES IN STARS. I. Lyman and Werner Bands of H_2 in the Solar Atmosphere. Krishna Swamy, K. S. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sol. Phys.; 41: No. 2, 301-312(Apr 1975).

The expected equivalent widths of the individual rotational lines of the Lyman and Werner bands of the hydrogen molecule from the solar atmosphere have been calculated. These results are used to predict what one expects to observe with a specified wavelength bandpass. These are compared with the observation of Dupree and Reeves. (auth)

24786 MAGNETIC STRUCTURE RESPONSIBLE FOR CORONAL DISTURBANCES: OBSERVATIONS. Altschuler, M. D. (High Altitude Observatory, Boulder, Col. (USA)). pp 3-33 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

Coronal disturbances are considered as consequences of the ejection of electric currents (or non-potential magnetic fields) from the photosphere and chromosphere into the corona. It may be that electric currents are generated near neutral lines in the photosphere and are later ejected into the corona. (auth)

24787 LARGE-SCALE MAGNETIC STRUCTURES RESPONSIBLE FOR CORONAL DISTURBANCES. Bumba, V. (Ceskoslovenska Akademie Ved, Ondrejov. Astronomicky Ustav); Sykora, J. (Slovenska Akademia Vied, Skalnate Pleso (Czechslovakia).

Astronomicky Ustav). pp 73-83 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

It is demonstrated that over the last 15 years the largest solar activity, usually connected with proton-flare occurrence, has been very closely related to a characteristic large-scale pattern in the magnetic field distribution with a life-time of the order of 8-10 solar rotations. These regular features are seen in the negative as well as in the positive polarity, although they can be seen better in the negative polarity where their forms are more pronounced, regardless of the activity cycle. The form alternates with the location in the northern or the southern solar hemispheres due to the mutual relations of both polarities, individual active regions, the influence of the differential rotations, the shift in longitude, etc. This pattern could be observed up to the large August 1972 proton-flare activity. The large-scale magnetic patterns described are accompanied by characteristic large-scale features in the green (λ5303) coronal emission, presented in the form of isophotes on the synoptic charts. Preliminary results concerning the correlation of the longitudinal distribution of the green coronal emission with the negative and the positive polarity fields for two time intervals (August 1960–September 1961 and January 1969–December 1969) are described. The existence of two "coronal active longitudes" in both intervals, as well as the close relation of these longitudinal emission maxima to certain parts of the large-scale characteristic bodies of negative polarity, is discussed. Also, the existence of one heliographic longitude, connected with "coronal holes" (minimal green corona emission), and its relation to the positive polarity large-scale pattern are proved. (auth)

24788 IMPULSIVE (FLASH) PHASE OF SOLAR FLARES: HARD X-RAY, MICROWAVE, EUV, AND OPTICAL OBSERVATIONS. Kane, S. R. (California Univ., Berkeley (USA). Space Sciences Lab.). pp 105-141 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

Recent observations of impulsive hard X-ray, microwave, EUV and optical emissions during solar flares are briefly reviewed in order to deduce the characteristics of the impulsive (flash) phase phenomenon in small solar flares particularly from the point of view of the acceleration of electrons and their role in producing the various impulsive phase emissions. Observed and deduced characteristics of the various electromagnetic emission sources are summarized. The deduced characteristics of the electron acceleration process indicate a process with high acceleration efficiency. The observations are found to be consistent with a model in which electrons are accelerated in a series of short pulses each lasting for $\lesssim 1$ s and the accelerated electrons provide the energy necessary for all the observed electromagnetic emissions produced during the flash phase of small solar flares. Models of the impulsive phase emissions in which energetic electrons play a prominent role are examined and crucial tests to check the accuracy of these models are indicated. (auth)

24789 CORONAL DISTURBANCES OBSERVED IN THE OPTICAL EMISSION LINES. Waldmeier, M. (Observatoire Federal, Zurich (Switzerland)). pp 149-154 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

Some examples are presented of fast variations of the structure and the intensity of coronal condensations. For the observations the lines λ5303 and λ5694 have been used. Most of the observed phenomena are flare-connected, but all of them are related to some kind of Hα activity. Sudden brightening of the emission lines may occur after the disappearance of a filament. The events have a duration of up to several hours and consist of hot clouds of high density that are slowly rising from the upper chromosphere into the lower corona. (auth)

24790 MULTIPLE HARD X-RAY BURSTS AND ASSOCIATED EMISSIONS. Vorpahl, J. (Sacramento City College, Sacramento, Calif., U. S. A.). pp 157-159 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

Multiple hard X-radiation, along with associated emission at optical and radio wavelengths is discussed for three events in particular: December 13, 1970-1832 UT; December 12, 1970-1843 UT; June 28, 1970-2001 UT. The two December flares occurred in different active regions separated by about 100000 km yet both produced hard X-ray bursts with similar structure. This suggests that the two regions were joined by extended field lines with the acceleration mechanism somewhere in between. Although nothing was visible in Hα (such as surges or post flare ejections) that would indicate connecting field lines, higher coronal structures could explain the similarity in hard X-rays from two separate regions. (auth)

24791 GROUND-BASED OBSERVATIONS OF TYPE III BURSTS. Stewart, R. T. (Commonwealth Scientific and Industrial Research Organization, Epping (Australia). Div. of Radiophysics). pp 161-181 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

Observations over the past 20 yrs or so are reviewed, with emphasis on recent high spatial resolution observations. The results lend support to earlier ideas on the propagation of type III electron streams through coronal regions of weak magnetic field strength but have not as yet settled the question whether the electrons propagate along the axes of coronal streamers. Several important burst properties appear to be significantly affected by ray scattering on small-scale size density irregularities in the corona. (auth)

24792 SOLAR RADIO BURSTS AT LOW FREQUENCIES. Fainberg, J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). pp 183-200 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

Properties of solar radio bursts observed by spacecraft at frequencies below several MHz are reviewed. In this frequency range most of the observed bursts are type III events (associated with particles) but several cases of type II emission (associated with shocks) have been reported. The analyses which lead to emission levels of type III solar bursts out to beyond 1 AU from the Sun also indicate that the low frequency radiation is observed at the harmonic of the emission region plasma frequency. Simultaneous particle and radio measurements imply that the bursts are generated near the leading edge of impulsive streams of solar electrons with energies extending from several hundred keV to several keV. Recent experiments measuring the direction of arrival of the radio emission allow the exciter particles to be tracked along the interplanetary magnetic field from regions near the Sun out to 1 AU. (auth)

24793 FLASH PHASE OF SOLAR FLARES: SATELLITE OBSERVATIONS OF ELECTRONS. Lin, R. P. (California Univ., Berkeley (USA). Space Sciences Lab.). pp 201-223 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

Satellite observations of solar electrons bearing on flare particle acceleration and the generation of radio and X-ray emission are reviewed. The observations support a two stage acceleration process for electrons, one stage commonly occurring at the flare flash phase and accelerating up to ~100 keV, and a second stage occurring only in large proton flares and accelerating electrons up to relativistic energies. The location of the acceleration region appears to be no lower than the lower corona. The accelerated non-relativistic electrons generate type III radio burst emission as they escape from the Sun. Direct spacecraft observations of the type III emission generated near 1 AU and the energetic electrons, provide quantitative information on the characteristics of the electrons exciting type III emission, the production of plasma waves, and the conversion from plasma waves to electromagnetic radiation. (auth)

24794 MECHANISMS FOR FLASH PHASE PHENOMENA IN SOLAR FLARES. Smith, D. F. (High Altitude Observatory, Boulder, Colo. (USA)). pp 253-282 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

Mechanisms for explaining the various forms to particles and radiation observed during the flash phase of solar flares are reviewed under the working hypothesis that the flash phase is the time in which electrons and to a lesser degree protons are accelerated in less than one second. A succession of such accelerations is allowed to explain longer lasting or quasi-periodic phenomena. Mechanisms capable of such acceleration are reviewed and it is concluded that first-order Fermi acceleration in a reconnecting current sheet is the most likely basic process. Such acceleration, however, gives rise to a rather narrow distribution of particle velocities along a given field line which is unstable to the production of electron plasma and ion-acoustic waves. This plasma turbulence can heat the plasma to produce soft X-rays and filter the initially narrow velocity distribution to produce a power law energy distribution. Electrons travelling inward from

the acceleration region produce hard X-rays by bremsstrahlung and microwave bursts by gyro-synchrotron emission. Whereas the interpretation of X-ray spectra is relatively straightforward, the interpretation of microwave spectra is difficult because the source at low frequencies can be made optically thick by several different mechanisms. The mechanisms for the conversion of plasma waves into radiation and the propagation of the radiation from its source to the observer are reviewed. (auth)

24795 SHOCK WAVES AND THE EJECTION OF MATTER FROM THE SUN: RADIO EVIDENCE. McLean, D. J. (Commonwealth Scientific and Industrial Research Organization, Epping (Australia). Div. of Radiophysics). pp 301-321 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

The passage of shock waves and ejected matter through the solar corona can produce type II and type IV radio bursts. This paper reviews the observations of these types of bursts and their interpretation, with particular emphasis on recent work. (auth)

24796 OPTICAL EVIDENCE FOR PLASMA EJECTIONS AND WAVES IN THE SOLAR CORONA. Bruzek, A. (Fraunhofer Institut, Freiburg i. Br., F. R. Germany). pp 323-332 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

Plasma ejections and waves in the solar corona are almost exclusively flare associated phenomena. Ejections of relatively cool and dense plasma are frequently observed in Hα whereas observations in coronal light (visible, EUV- and X-radiation) are still rather scarce. Occurrence of coronal waves is so far best known from their effects on the Hα chromosphere and, of course, from the production of radio bursts. Only in relatively few cases have observations been made in coronal lines and in coronal continuum by ground based as well as by satellite borne equipment. It may be expected, however, that the white light coronagraph and the X-ray telescopes on board of the Skylab will detect quite a number of events in front of the solar disk and high in the solar corona and will considerably increase and improve the imperfect knowledge and understanding of coronal ejections and waves as it is presented in this review. (auth)

24797 THEORY OF SHOCK WAVES AND PLASMA WAVE-EMISSION. Krall, N. A. (Science Applications, Inc., La Jolla, Calif. (USA)). pp 365-375 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

The theory of shock waves in a hot plasma is reviewed, and the types of shock waves which can exist are summarized. The detailed application of shock wave theory to the explanation of laboratory experiments is described; a comparison is made between the results of these experiments and the observations made of type II radio bursts from the Sun. (auth)

24798 THERMAL INTERPRETATION OF HARD X-RAY BURSTS FROM SOLAR FLARES. Brown, J. C. (Glasgow Univ. (UK)). pp 395-412 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

The possible validity of thermal bremsstrahlung models of flare hard X-ray bursts is investigated quantitatively. In particular, the problem of rapid thermal conduction in "multi-temperature" models is adequately examined for the first time by using a continuous temperature distribution consistent with the observed X-ray spectrum. This distribution is obtained from a general analytic solution for the temperature structure required to mimic any "non-thermal" spectrum, the method being equally applicable to cosmic sources. It is concluded that the thermal interpretation might extend to X-rays of hundreds of keV, a result with important consequences for flare energies. The relationship of such a model to observations of X-ray polarization and rapid time variations is also considered. (auth)

24799 CHARGE AND ISOTOPIC COMPOSITION OF SOLAR COSMIC RAYS. McDonald, F. B. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). pp 415-420 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1975).

The charge and isotopic composition of solar cosmic rays potentially contain a wealth of information on the acceleration and confinement of energetic particles at the Sun. As the experimental techniques have improved and with the increasing number of measurements, this potential is now being realized. It is convenient to divide the composition studies into three areas: helium-iron, with energies > 10 MeV nuc^{-1}; helium-iron, and the trans-iron elements, with energies < 2 MeV nuc^{-1}; the isotopic composition. In the first area at energies above 10 MeV nuc^{-1} the solar cosmic rays appear to provide a representative sample of the solar corona. At lower energies complex enhancement effects are noted. These increase with Z and decrease with energy. This result as well as the high abundance of ^{3}He suggest that the acceleration process is not a simple one and probably several stages are required. (auth)

24800 ACCELERATION, CONTAINMENT, AND EMISSION OF HIGH ENERGY FLARE PARTICLES: RADIO EVIDENCE. Boischot, A. (Observatoire de Paris, Section de Meudon, 92 (France)). pp 423-435 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

The existence of non thermal radio bursts provide evidences for the acceleration of electrons in the solar atmosphere. It is shown, from the characteristics of the bursts, that the electrons are accelerated in at least four different phases: An impulsive phase which gives μ^{ib} and III bursts. A gradual phase which gives μIV and S_1IV bursts. A quasi-continuous phase which gives S_2IV bursts and noise storms. An acceleration by shock waves gives type II bursts. Eventually, another shock-wave acceleration giving the moIV burst. (auth)

24801 PARTICLE ACCELERATION IN SOLAR FLARES. Sturrock, P. A. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). pp 437-445 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

A review of observational data supports the proposal that there are two distinct phases of particle acceleration in solar flares. "Phase 1" is associated with the flash phase and is here interpreted as acceleration during field-line reconnection. "Phase 2" is associated with type II and type IV radio bursts, and is ascribed to stochastic acceleration in the turbulent plasma behind a magnetohydrodynamic shock formed ahead of an ejected plasmoid. (auth)

24802 MILLIMETER RADIO EVIDENCE FOR CONTAINMENT MECHANISMS IN SOLAR FLARES. Mayfield, E. B.; White, K. P. III; Shimabukuro, F. I. (Aerospace Corp., El Segundo, Calif. (USA)). pp 447-460 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

Recent theories of solar flares are reviewed with emphasis on the aspects of pre-flare heating. The heating evident at 3.3-mm wavelength is analyzed in the form of daily maps of the solar disk and synoptic maps compiled from the daily maps. It is found that isotherms defining antenna temperature enhancements of 340 K correspond in shape and location to facular areas reported by Waldmeier. Maximum enhancements occur over sunspots or near neutral lines of the longitudinal magnetic fields which indicates heating associated with chromospheric currents. These enhancements are correlated with flare importance number and are observed to increase during several days preceding flaring. This evidence for a containment mechanism in the chromosphere is collated with current theories of solar flares. (auth)

24803 ACCELERATION, CONTAINMENT, AND EMISSION OF VERY LOW ENERGY SOLAR FLARE PARTICLES. Lin, R. P.; McGuire, R. E.; Anderson, K. A. (California Univ., Berkeley (USA). Space Sciences Lab.). pp 461-469 of Coronal Disturbances. Newkirk, G. N. Jr. (ed.). Dordrecht, Netherlands; Reidel (1974).

From conference on coronal disturbances; Surfers Paradise, Queensland, Australia (7 Sep 1973).

The observations of protons down to 44 keV and electrons down to $\lesssim$ 2 keV emitted in an impulsive solar particle event are presented. The observations are from the Apollo 15 Subsatellite during a flare event which began on September 1, 1971. A lower limit estimate is obtained of the energy contained in $\gtrsim$ 0.05 MeV protons in the flare. The effects of adiabatic deceleration in the interplanetary medium and dE/dx energy loss in the corona are discussed. It is concluded that energetic protons may constitute a major energy release in large solar flares. (auth)

24804 EUV EMISSION, FILAMENT ACTIVATION, AND MAGNETIC FIELDS IN A SLOW-RISE FLARE. Rust, D. M. (Sacramento Peak Observatory, Air Force Cambridge Research Laboratories, Sunspot, New Mexico, USA); Nakagawa, Y. (High Altitude Observatory, Boulder, Colo. (USA)); Neupert, W. M. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sol. Phys.; 41: No. 2, 397-414 (Apr 1975).

The evolution of coronal and chromospheric structures is examined together with magnetograms for the 1B flare of January 19, 1972. Soft X-ray and EUV studies are based on the OSO-7 data. The Hα filtergrams and magnetograms came from the Sacramento Peak Observatory. Theoretical force-free magnetic field configurations are compared with structures seen in the soft X-ray, EUV and Hα images. Until the flare, two prominent spots were connected by a continuous dark filament and their overlying coronal structure underwent an expansion at the sunspot separation rate of 0.1 km s^{-1}. On January 19, the flare occurred as new magnetic fields emerged at ~10^{19} Mx h^{-1} beneath the filament, which untwisted and erupted as the flare began. The pre-flare coronal emissions remained unchanged during the flare except for the temporary addition of a localized enhancement that started 5 min after flare onset. EUV lines normally emitted in the upper transition region displayed a sudden enhancement coinciding in time and location with a bright Hα point, which is believed to be near the flare "trigger" or onset point. The EUV flash and the initial Hα brightening, both of which occurred near the center of the activated filament, were followed by a second EUV enhancement at the end of the filament. The complete disruption of the filament was accompanied by a third EUV enhancement and a rapid rise in the soft X-ray emission spatially coincident with the disappearing filament. From the change of magnetic field inferred from Hα filtergrams and from force-free field calculations, the energy available for the flare is estimated at approximately 10^{31} erg. Apparently, changes in the overlying coronal magnetic field were not required to provide the flare energy. Rather, it is suggested that the flare actually started in the twisted filament where it was compressed by emerging fields. Clearly, the flare started below the corona, and it appears that it derived its energy from the magnetic fields in or near the filament. (auth)

24805 BEHAVIOUR OF THE HYDROGEN LYMAN SERIES IN FLARES. de Feiter, L. D. (The Astronomical Institute, Utrecht, The Netherlands); Svestka, Z. (Fraunhofer Institut, Freiburg, Federal Republic of Germany). Sol. Phys.; 41: No. 2, 415-424 (Apr 1975).

The Lyman spectrum of hydrogen has been computed for a number of flare models, characterized by the column density of hydrogen atoms in the ground state (N_1), the electron density (n_e) and the electron temperature (T_e). Broadening by the thermal Doppler effect and by Stark effect has been accounted for. The source functions for the individual lines of the series have been derived from non LTE calculations of the excitation in hydrogen flares. The aim of the investigation is to evaluate the use of the intensities in between two successive Lyman lines for a determination of the value for N_1, which is a physical parameter of the flare for which only indirect determinations are available. Whilst in principle this method could give reliable results, its practical application meets with difficulties which hardly can be overcome. Therefore, one probably has to base the N_1 determination on the highest line resolvable in the spectrum. (auth)

24806 SUNSPOT MOTION, FLARES, AND TYPE III BURSTS IN MCMATH 11482. Zirin, H.; Lazareff, B. (Hale Observatories, Pasadena, Calif. (USA)). Sol. Phys.; 41: No. 2, 425-438(Apr 1975).

A series of flares in McMath 11482, 1972 August 19-22 have been studied, with particular reference to the basis for the flares and comparison with dekameter radio data. It is found that the flares were produced by rapid (~1000 km h^{-1}) westward motion of a large new p spot. Many flares occur just in front of the spot, and they cease when the motion stops. All flares occurring in front of the spot produce type III bursts, while even strong flares elsewhere in the region produce little or no type III. The time of type III emission agrees perfectly with the start of the Hα flare. Thus type III bursts are only produced in favorable configurations. Simultaneous K-line movies are compared with Hα films and show little difference in flare appearance. (auth)

24807 NECESSITY OF FUNDAMENTAL EMISSION IN TYPE III BURSTS. Smith, D. F.; Davies, W. D. (High Altitude Observatory, Boulder, Colo. (USA)). Sol. Phys.; 41: No. 2, 439-447 (Apr 1975).

Observations of some type III radio bursts in the hectometer and kilometer wave range are compared with theoretical predictions. It is shown that the burst emission must be near the plasma frequency in the region between $10R_\odot$ and $50R_\odot$ in order to be consistent with the observed steep rise in brightness temperature for these bursts. The results of Fainberg, Malitson et al., and Haddock and Alvarez are discussed and compared with the interpretation of emission near the plasma frequency. (auth)

24808 HEAVY SOLAR COSMIC RAYS IN THE JANUARY 25, 1971 SOLAR FLARE. Pellerin, C. J. Jr. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sol. Phys.; 41: No. 2, 449-458(Apr 1975).

A detailed study of the charge composition of heavy solar cosmic rays measured in the January 25, 1971 solar flare including differential fluxes for the even charged nuclei from carbon through argon is presented. The measurements are obtained for varying energy intervals for each nuclear species in the energy range from 10 to 35 MeV $nucleon^{-1}$. In addition, abundances relative to oxygen are computed for all the above nuclei in the single energy interval from 15 to 25 MeV $nucleon^{-1}$. This interval contains measurements for all of the species and as a result requires no spectral extrapolations. An upper limit for the abundance of calcium nuclei is also presented. These measurements, when combined with other experimental results, enable the energy dependence of abundance measurements as a function of nuclear charge to be discussed. It is seen that at energies above about 10 MeV $nucleon^{-1}$, the variations of abundance ratios are limited to about a factor of 3 from flare to flare, in spite of large variations in other characteristics of these solar events. (auth)

24809 DETERMINATION OF THE UPPER CUTOFF OF THE 1-2 SEPTEMBER 1971 PROTON EVENT FROM SATELLITE MEASUREMENTS. Heristchi, D. J.; Trottet, G. (Observatoire de Paris, Section de Meudon, 92 (France)). Sol. Phys.; 41: No. 2, 459-460(Apr 1975).

The existence of an upper cutoff in the solar proton spectrum has been shown by Heristchi and Trottet (1971). In this work, the differential spectrum, against energy or rigidity, is represented by a power law, the exponent of which is γ or μ, respectively. This law holds up to a maximum energy E_m or a maximum rigidity R_m beyond which the intensity drops to zero. (auth)

24810 LONG TERM EVOLUTION OF SOLAR SECTOR STRUCTURE. Svalgaard, L.; Wilcox, J. M. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Sol. Phys.; 41: No. 2, 461-475(Apr 1975).

The large-scale structure of the solar magnetic field during the past five sunspot cycles (representing by implication a much longer interval of time) has been investigated using the polarity (toward or away from the Sun) of the interplanetary magnetic field as inferred from polar geomagnetic observations. The polarity of the interplanetary magnetic field has previously been shown to be closely related to the polarity (into or out of the Sun) of the large-scale solar magnetic field. It appears that a solar structure with four sectors per rotation persisted through the past five sunspot cycles with a synodic rotation period near 27.0 days, and a small relative westward drift during the first half of each sunspot cycle and a relative eastward drift during the second half of each cycle. Superposed on this four-sector structure there is another structure with inward field polarity, a width in solar longitude of about 100° and a synodic rotation period of about 28 to 29 days. This 28.5 day structure is usually most prominent during a few years near sunspot maximum. Some preliminary comparisons of these observed solar structures with theoretical considerations are given. (auth)

24811 RELATIONSHIPS BETWEEN SFE (CROCHET) AND SOLAR X-RAY AND MICROWAVE BURSTS. Sastri, J. H.; Murthy, B. S. (Indian Inst. of Astrophysics, Kodaikanal). Sol. Phys.; 41: No. 2, 477-485(Apr 1975).

Geomagnetic crochets (sfe) observed at Kodaikanal over the period 1966-71 have been studied in relation to solar X-ray bursts observed by NRL satellite (SOLRAD-9) in the 0.5-3 Å, 1-8 Å and 8-20 Å bands and radio bursts observed in the frequency range 1000-17000 MHz. The amplitude of sfe is linearly correlated with the peak intensities of X-ray bursts in the 1-8 Å and 8-20 Å bands. The single frequency correlation of sfe with radio bursts is a flat maximum in the frequency range 2000-3750 MHz. Following the spectral classification of AFCRL for microwave bursts, it is noticed that sfe are mostly associated with the "A" type burst spectra and are very poorly correlated with bursts with the "G", "C" and "M" type spectra. These features differ from those of other SID's reported earlier. (auth)

24812 AUTOMATIC SOLAR IMAGE MOTION MEASUREMENTS. Colgate, S. A.; Moore, E. P. (New Mexico Inst. of Mining and Technology, Socorro (USA)). Sol. Phys.; 41: No. 2, 487-498(Apr 1975).

The solar seeing image motion has been monitored electronically and absolutely with a 25 cm telescope at three sites along the ridge at the southern end of the Magdalena Mountains west of Socorro, New Mexico. The uncorrelated component of the variations of the optical flux from two points at opposite limbs of the solar disk was continually monitored in 3 frequencies centered at 0.3, 3 and 30 Hz. The frequency band of maximum signal centered at 3 Hz showed the average absolute value of image motion to be somewhat less than 2″ although wide variations from ≥ 20″ to an extraordinary quiet day of less than the measurement limit of ½″ were observed. The observer estimates of combined blurring and image motion were well correlated with electronically measured image motion, but the observer estimates gave a larger value ~ X 2 presumably because the electronic mea-

surement gave only the uncorrelated motion of opposite limbs. Approximately 30% of the total solar time would allow spatial position measurements of solar features to a precision ≤ 2" and, from the visual estimates, blurring limited measurements to a precision ≤ 4". (auth)

24813 X-RAY BRIGHT POINTS, CORONAL HEATING AND THE SOLAR CYCLE. Gokhale, M. H. (Physical Research Lab., Ahmedabad (India)). Sol. Phys.; 41: No. 2, 381-386(Apr 1975).

Recent Skylab observations about the bright points in the solar X-ray images seem to confirm an essential prediction of a model proposed by this author for the appearance and the disappearance of the photospheric fields during a solar cycle. The segments of the individually rising strands of the "fundamental flux-loops" proposed in the model may lead to the X-ray bright points with the observed properties. The emergence of such strands may substantially contribute to the coronal heating at different heights. (auth)

24814 HYDROMAGNETIC WAVES IN STRUCTURED MAGNETIC FIELDS. Cram, L. E.; Wilson, P. R. (Sydney Univ. (Australia). Dept. of Applied Mathematics). Sol. Phys.; 41: No. 2, 313-327(Apr 1975).

Although the inhomogeneous nature of solar magnetic fields is now well established, most theoretical analyses of hydromagnetic wave propagation assume infinite homogeneous fields. Here the hydromagnetic wave problem for magnetic fields which vary in one direction perpendicular to the field is reformulated. The permitted modes of small amplitude hydromagnetic oscillations are considered, first in the case of a single interface between semi-infinite magnetic and non-magnetic compressible regions, and secondly for a magnetic flux sheath of given thickness imbedded in a non-magnetic region. It is shown that, for small values of R(the ratio of the Alfvén to the sound speed), an acoustic or p-mode wave front passes through the flux sheath with only minor deformation. However, for large R, the transmitted acoustic wave is attenuated and, depending upon the thickness of the flux sheath and the angle of incidence, a hydromagnetic wave may be effectively trapped and guided along the flux sheath. It is also shown that, for the symmetric vibration of the flux sheath in the absence of incident acoustic waves, only slow mode type waves are permitted. Thus, in compressible regions for which R > 1 the Alfvénic-type fast mode is not a permitted mode of free vibration of a flux sheath. (auth)

24815 SPECTRAL FEATURES TO BE EXPECTED FROM ROTATIONAL AND EXPANSIONAL MOTIONS IN FINE SOLAR STRUCTURES. Rompolt, B. (Wroclaw Univ. (Poland). Obserwatorium Astronomiczne). Sol. Phys.; 41: No. 2, 329-348(Apr 1975).

The shapes and spectral features (lines) to be expected from rotating or expanding fine solar filaments, loops, and knots (oriented variously to the spectrograph slit) are given and discussed. Only the appearance of the lines in the spectrum (i.e., their orientation to the direction of dispersion and the shape of their area) is considered. It is shown that the observed inclination to the direction of dispersion of some spectral features can be produced by rotation but not by expansion. The observational evidences are given. (auth)

24816 CORRELATION OF CORONAL GREEN-LINE INTENSITY AND SOLAR WIND VELOCITY. Roelof, E. C. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.); Cuperman, S.; Sternlieb, A. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). Sol. Phys.; 41: No. 2, 349-366(Apr 1975).

Cross-correlation functions have been computed between green-line intensity (Kislovodsk) and Vela solar wind velocity January–June 1967. They are calculated separately for east and west limb observations in 5° latitude increments, and the solar wind velocities are correlated at their estimated emission times by correcting for the plasma Earth-Sun transit time using the observed velocities. The cross-correlation patterns appear to be dominated by two competing effects: a tendency of quasi-stationary green-line emission and solar wind velocity to anti-correlate; and a tendency of transient green-line emission and solar wind velocity enhancements to correlate positively. Evidence is also found for simultaneous (same-day) emission brightenings over 2 to 4 limb quadrants. It is therefore recommended that, following a well-known practice in solar terrestrial studies, recurrent and transient events in both solar wind and green-line emissions should be studied separately. (auth)

24817 COMMENT ON THE PAPER "TWO-FLUID MODEL OF THE SOLAR CORONA" BY J. W. KNIGHT, C. E. NEWMAN, AND P. A. STURROCK. Billings, D. E. (Colorado Univ., Boulder (USA). Dept. of Astro-Geophysics). Sol. Phys.; 41: No. 2, 367-369(Apr 1975).

Observational line width evidence for a possible discrepancy between ion and electron temperature in the corona is reviewed for comparison with the conclusions of Knight et al. It is noted that the high line width temperatures extend much higher in the corona than the high ion temperatures computed by Knight et al., and it is suggested that a significant ion-electron temperature difference should be expected only near a steep temperature gradient, as in the transition region. (auth)

24818 REPLY TO BILLINGS CONCERNING "TWO-FLUID MODEL OF THE SOLAR CORONA". Knight, J. W.; Newman, C. E.; Sturrock, P. A. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Sol. Phys.; 41: No. 2, 371(Apr 1975).

It is maintained that the hypothesis presented in Knight et al., 1974 is not contradicted by the models considered in that paper. Further investigation of a wider range of models may show that the large line-width temperature at greater heights cannot be explained using the limited range of cases possible from the basic hypothesis. (auth)

24819 THEORETICAL POPULATION OF THE LOWEST ZEEMAN LEVELS RELATIVE TO THE 5303A FeXIV LINE. Rozelot, J. P. (Observatoire du Pic du Midi, 65 - Bagneres-de-Bigorre (France)). Sol. Phys.; 41: No. 2, 373-379(Apr 1975). (In French).

Under compact tables, the relative population of the six first levels arising from the hyperfine structure of Fe XIV are given. These populations are computed from the best atomic data actually available, so that one can have a well known basis for the interpretation of coronal polarization measurements, both theoretical and observational. (auth)

24820 MEASUREMENTS OF SOLAR MAGNETIC FIELDS BY FOURIER TRANSFORM TECHNIQUES. I. Unsaturated Lines. Title, A. M.; Tarbell, T. D. (Lockheed-California Co., Burbank (USA)). Sol. Phys.; 41: No. 2, 255-269(Apr 1975).

If the basic profile shapes of the normal Zeeman triplet do not have zeros in their Fourier transform, the magnetic field splitting can be determined independent of the profile shape. When the ratio of the splitting of the components is greater than the intrinsic FWHM of the component profiles the magnetic splitting can be determined with significantly greater accuracy than the measurement accuracy of the original profile. For Gaussian shaped components and a ratio of magnetic splitting to FWHM of 1.5 the noise reduction factor is 25. (auth)

24821 INHOMOGENEOUS MODEL OF THE PHOTOSPHERE. Turon, P. (Paris-7 Univ., 75 (France)). Sol. Phys.; 41: No. 2, 271-288(Apr 1975).

A new method for the construction of empirical models of photosphere is developed starting with a first approximation called "multicolumn". The old idea of two or three column models is thus kept but completed by the following ideas: -A good photograph of granulation is a fair representation of topological features along x and y. -Vertical distributions T(z), P(z) cannot be very much different from distributions given by stellar atmosphere models in radiative and hydrostatic equilibrium. The sampling interval (200 km) is such that a "granule" is represented by 10 to 30 columns. Horizontal transfer is computed explicitly at each point. Corrections are introduced in the model but are not of significant importance; temperature differences of 1000 K or more at the same geometrical depth in the $\tau = 1$ region are compatible with a life time of the order of 10 min. The importance of pressure is emphasized: significant pressure excess in the granule is suggested a priori. Results tend to confirm this hypothesis. (auth)

24822 LONG TERM VARIATION OF THE SOLAR EQUATORIAL VELOCITY AND ITS RELATION TO NON-AXISYMMETRIC CONVECTION. Belvedere, G. (Instituto di Astronomia dell' Universita di Catania, Catania, Italy); Paterno, L. (Osservatorio Astrofisico di Catania, Catania, Italy). Sol. Phys.; 41: No. 2, 289-295(Apr 1975).

The long term variations of solar equatorial velocity are considered, as determined by spectroscopic observations of several authors since 1900. By eliminating Storey's observations covering the period 1914-1932 which seem to be affected by casual errors, a computer analysis picks out a period of about 34 yr in the velocity variation. An interpretation is given of this period in the framework of the interaction of non-axisymmetric convection with rotation. (auth)

24823 ANTICORRELATION BETWEEN POLAR AND EQUATORIAL ROTATION OF THE SOLAR PHOTOSPHERE. Wolff, C. L. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sol. Phys.; 41: No. 2, 297-300(Apr 1975).

Published spectroscopic measurements of solar rotation are analyzed to show that when the rotation velocity increases at high latitudes it tends to decrease at low latitudes, and conversely. The high latitude velocities typically vary over only 20% of the range of those near the equator and the smallest variations of all occurred

near latitude 60° during the rising portion of the previous solar cycle. The anticorrelation is consistent with a recent suggestion that differential rotation on the sun arises from photospheric wind systems whose strength is determined, ultimately, by oscillations within the Sun. (auth)

24824 DYNAMIC RESPONSE OF AN ISOTHERMAL STATIC CORONA TO FINITE-AMPLITUDE DISTURBANCES. Nakagawa, Y.; Wu, S. T.; Tandberg-Hanssen, E. (High Altitude Observatory, Boulder, Colo. (USA)). Sol. Phys.; 41: No. 2, 387-396(Apr 1975).

The velocity evolution of sprays, surges and fast ejections is characterized by a rapid acceleration followed by a slowdown. In contrast, eruptive prominences show a velocity evolution with a slow increase followed by a rapid acceleration. The physical causes which differentiate these two characteristic velocity evolutions are examined and the dynamic responses of the solar corona studied. For simplicity, the ascending disturbances are modelled as purely radial adiabatic flows caused by finite-amplitude perturbations (pulses) in an initially isothermal, static corona. It is shown that the resultant flow depends strongly on the nature of the disturbing causes. In particular, the coronal response to sprays and fast ejections can be identified with temperature and velocity pulses at the bottom of the corona, with surges related to shorter pulses, while the slow moving eruptive prominences are correlated with density pulses. It is shown that for large flare sprays 5 X 10^{39} particles can be injected into the solar wind. (auth)

24825 RECENT PROGRESS IN THE CLASSIFICATION OF THE SPECTRA OF HIGHLY IONIZED ATOMS. Fawcett, B. C. (Culham Lab., Abingdon, Eng.). Adv. At. Mol. Phys.; 10: 223-293(1974).

Recent contributions to the understanding of multiply ionized systems and their solar applications are reviewed. Laboratory spectral sources, such as theta pinch plasmas, laser produced plasmas, high voltage vacuum spark, low-inductance high capacity spark, and beam foil spectroscopy are described. Some experimental and measuring techniques which are of benefit are described. Theoretical calculations of atomic structure are presented, and a comprehensive account of new line classifications of spectra of highly ionized atoms is given (with a full indexed reference list to recent work). The theoretical calculations are applied to the solar corona, and a table of the observed solar spectrum is given with a list of line identifications. (14 figures, 7 tables, 299 references) (GHT)

Galaxies

Refer also to abstracts 24776, 24781, and 24865.

24826 GIANT RADIO GALAXIES. Strom, R. G.; Miley, G. K.; Oort, J. Sci. Am.; 233: No. 2, 26-35(Aug 1975).

A radio telescope in the Netherlands is used to study energetic radio sources associated with galaxies. It appears that double structure is the preferred morphology for strong radio sources outside our galaxy. Models of giant radio galaxies are discussed. (BJG)

24827 THE GALAXY AND INTERSTELLAR MEDIUM. Osborne, J. L. (Durham Univ. (UK)). pp 13-24 of Origin of Cosmic Rays. Osborne, J. L.; Wolfendale, A. W. (eds.). Dordrecht, Netherlands; Reidel (1975).

From conference on the origin of cosmic rays; Durham, U. K. (26 Aug 1974). 15 refs.

The galactic setting for the propagation and possible origin of cosmic rays is described. A description of the overall structure and constituents of the Galaxy is followed by an account of the physical properties and distribution of the interstellar medium. An attempt is made to solve the problem of covering such a broad subject in a brief review by concentrating on those features which are judged to have a direct bearing on the origin and propagation of cosmic rays. (auth)

24828 MODELS FOR THE FORMATION AND EVOLUTION OF SPHERICAL GALAXIES. Larson, R. B. (Yale Univ., New Haven, Conn. (USA). Observatory). pp 191-194 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Detailed dynamical model calculations based on a conventional collapse picture of galaxy formation, and conventional assumptions concerning star formation and stellar evolution, are found to be able to reproduce satisfactorily the basic structural and photometric properties of elliptical galaxies. The quasar phenomenon may be identifiable with the formation of the nucleus of a giant elliptical galaxy. (auth)

24829 DYNAMICS OF ROTATING STELLAR SYSTEMS: COLLAPSE AND VIOLENT RELAXATION. Gott, J. R. III (California Inst. of Tech., Pasadena (USA)). pp 181-190 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Axisymmetric systems, having differing amounts of initial angular momentum and containing 2000 stars (mass points) each, are allowed to collapse under their own gravitational attraction. Collapse and violent relaxation are found to lead to the formation of equilibrium structures after only a few free-fall times. The systems contain a sufficient number of mass points so as to be effectively collisionless and the equilibrium structures are consistent with accurate satisfaction of the stationary collisionless Boltzmann equation. Rotating equilibrium models produced in this way resemble elliptical galaxies, with elliptical isophotes. With cosmologically reasonable amounts of initial angular momentum, E0 to E4.5 galaxies can be produced. The equilibrium models show rotation curves in general agreement with that expected from violent relaxation theory. In particular the models show a central region with solid-body rotation. Further out, the systems become differentially rotating. When infall effects are included one can produce models with extended envelopes in good agreement with observed elliptical galaxies. It is suggested that the crucial factor in determining whether an elliptical or a spiral galaxy is formed is whether or not star formation is complete by the time the proto-galaxy reaches its point of maximum collapse. (auth)

24830 STUDIES ON THE GALACTIC DENSITY WAVE. Mark, J. W. K. (Massachusetts Inst. of Tech., Cambridge (USA)). pp 417-423 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

For spiral galaxies, investigations have been made as to the behaviour of density waves at the critical regions of the Lindblad and co-rotation resonances and in particular as to their role in the maintenance and generation of these waves. The conditions under which an inner resonance ring may be formed are discussed. It is found that the co-rotation region acts as a wave-amplifier. (auth)

24831 SOME RECENT DEVELOPMENTS IN THE THEORY OF SPIRAL STRUCTURE. Contopoulos, G. (University of Thessaloniki, Greece). pp 413-415 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Particle resonance, the density wave at the centre of a galaxy, trapping of orbits around barred spirals and a quasi-linear theory of density waves are discussed in the context of spiral structure in galaxies. (NL)

24832 INTERPRETATION OF OBSERVATIONS OF SPIRAL STRUCTURE IN TERMS OF THE DENSITY WAVE THEORY. Lindblad, P. O. (Stockholm Observatory, Sweden). pp 399-412 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

A review is given of recent theoretical and observational work on the density wave theory of spiral structure. Emphasis is put on the kinematic picture, and the question whether modern observations reveal the existence of density waves is discussed. (auth)

24833 RECENT RADIO STUDIES OF BRIGHT GALAXIES. Oort, J. H. (Sterrewacht te Leiden, The Netherlands). pp 375-397 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Some results are discussed of recent—still largely unpublished—high-resolution studies of bright spirals, both in the radio continuum and in the 21 cm line radiation. Special emphasis is given to observations of M51, M81 and NGC 4258. The most important new data are (1) Estimates of the contrast in gas density between arms and interarm regions (M81 and M101); the contrast appears to be quite strong. It provides an important parameter for the density wave. (2) Evidence for a pronounced decrease of gas density along the arms when these are followed towards the centre. Considerable line radiation is observed from outer regions where the optical intensity of the arms is very low. (3) Extension of rotation curves to larger distances from the centre.

(4) Data on the motions in the spiral waves. (5) Determination of the shift between synchrotron and optical arms, providing direct evidence for the formation of stars as a consequence of the passage of the interstellar gas through the spiral density wave. From the shift measured in M51 the formation time is found to be roughly ten million years. If the data for (2) are ascribed to the depletion of the gas by star formation, the average net fraction of the gas consumed in star formation is found to be between 2% and 3% per passage through the spiral wave. (6) Separation of nuclear and disk synchrotron radiation in spirals. (7) Evidence for a recent expulsion of about 10^8 solar masses from the nuclear region of NGC 4258. (auth)

24834 THE MAGELLANIC STREAM. Mathewson, D. S.; Cleary, M. N. (Australian National Univ., Canberra. Mount Stromlo and Siding Spring Observatories). pp 367-374 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

A southern sky survey of H I in the velocity range −340 km s^{-1} to +380 km s^{-1} has shown that a long filament of H I extends from the Small Magellanic Cloud (SMC) region down to the South Galactic Pole and connects with the long H I filament discovered recently by Wannier and Wrixon (1972) and van Kuilenburg (1972). There is also some evidence that the feature continues on the other side of the Magellanic Clouds and crosses the galactic plane at l = 306°. The whole filament, which follows very closely a great circle over its entire 180° length, is given the name "The Magellanic Stream". It may have been produced by gravitational interaction between the SMC and the Galaxy during a close passage (20 kpc) of the SMC some 5×10^8 yr ago although it is impossible to account for the observed radial velocities along the Stream unless some force other than gravity is invoked to act on the Stream as well. (auth)

24835 GRAVITATIONAL INTERACTIONS BETWEEN GALAXIES. Toomre, A. (Massachusetts Inst. of Tech., Cambridge (USA)). pp 347-365 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Recent theoretical studies of the consequences of fierce tidal interactions between galaxies are reviewed and compared. Some of the pronounced spiral galaxies may owe their present appearances to the tidal forces of neighbours, and recent demonstrations show that certain narrow "streamers", "filaments" and "tails" of peculiar galaxies may have had tidal origins. (NL)

24836 VARIABILITY OF THE EMISSION LINE SPECTRUM OF THE NUCLEUS OF SEYFERT GALAXY NGC 1275. Pronik, I. (AN SSSR, Crimea. Krymskaya Astrofizicheskaya Observatoriya). pp 341-345 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Recent spectroscopic observations of the nucleus of NGC 1275, together with results from earlier workers, confirm the variability of the emission lines and indicate corresponding variations in the electron temperatures and densities of different zones. These changes may be associated with the microwave outbursts from this source. (auth)

24837 STRUCTURES OF CENTRAL BULGES AND NUCLEI OF GALAXIES. De Vaucouleurs, G. (Texas Univ., Austin (USA)). pp 335-340 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

The isophotal surfaces of central bulges of normal spirals, often described as "spheroidal", are shown to depart from ellipsoids of revolution and to resemble MacLaurin or Jacobi spheroids with zonal distortion: two typical examples, NGC 4565, 5746, are illustrated. Weaker examples are NGC 2683, 4594 and 891. Stronger examples are NGC 7332 and 128. The true nucleus of an ordinary spiral is at most a very small object (~10 pc) resolved only in the nearest galaxies. The apparently larger nuclei seen in more distant spirals and lenticulars, in particular the so-called N-types, are probably artifacts due to insufficient resolution. It is possible that even in M31 the small "nucleus" is merely the seeing-convolved image of the central peak in the $r^{\frac{1}{4}}$ luminosity distribution of the spheroidal component. In the nearest barred lenticulars and early spirals each large ellipsoidal "nucleus" (~1.0×1.5 kpc) in the centre of the bar or central lens is found to include a second bar and inner nucleus on a smaller scale, in the approximate ratio of the corresponding Jeans' lengths. This is illustrated by high resolution photographs of NGC 1291; another example is NGC 1326. (auth)

24838 THEORY OF GALACTIC NUCLEI. Saslaw, W. C. (National Radio Astronomy Observatory, Charlottesville, Va. (USA)). pp 305-334 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Current ideas about the possible constituents of galactic nuclei, and the mechanisms for ejecting gas and massive objects are reviewed. The following are considered: (1) electromagnetic radiation, (2) gas, (3) dust, (4) stars, (5) supermassive objects, (6) rotating magnetoids, (7) pulsar systems, (8) singularities in general relativity, (9) accretion disks, (10) anti-matter, (11) gravitational radiation, and (12) new physics. (auth)

24839 OPTICAL OBSERVATIONS OF NUCLEI OF GALAXIES. Ulrich, M. H. (Texas Univ., Austin (USA)). pp 279-304 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Spectrophotometry in the near infrared shows that the late-type stars in the nucleus of M31 are mostly late giants; the M/L ratio in the nucleus is approximately 15, a value in agreement with that calculated independently from the velocity dispersion of the stars. Infrared emission at 10μ has now been detected in 50 galaxies; the Seyfert-type galaxies are the brightest at 10μ and there is evidence of variations of the 10μ flux in NGC 4151, which rules out re-radiation by dust as the mechanism of infrared emission. In each of the galaxies NGC 253 and NGC 3034 an infrared source of dimension ~200 pc is present in the centre which coincides in position and dimension with the central component of the radio source at 1415 MHz; since both galaxies are rich in dust and in early-type stars it is plausible that, in these cases, re-radiation by dust is the origin of the infrared emission. Most of the other galaxies detected at 10μ are spirals with intense and narrow emission lines. Comparison of the optical and radio properties of nuclei of galaxies show that galaxies with compact nuclear radio sources are more likely to have optical spectra with emission lines than are galaxies without central radio sources. This correlation holds for elliptical and spiral galaxies. Its cause is not understood at present. The relatively accurate profiles now available for the permitted lines of several Seyfert galaxies show that mass motions are the main broadening agent for these lines. Variations of line intensities have been observed in several Seyfert galaxies. The most likely explanation of these variations is that they are due to the variations of the photoionizing flux; in some cases, however, weakening of the permitted lines could be caused by high velocity mass motions present in the region emitting the broad component of these lines. From the investigation of the relatively nearby galaxies it is estimated that at least 5% of galaxies have expansion motions or non-thermal optical fluxes. (auth)

24840 RADIO FREQUENCY OBSERVATIONS OF THE NUCLEI OF GALAXIES. Ekers, R. D. (Rijksuniversiteit Groningen (Netherlands)). pp 257-277 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

For spiral galaxies the nuclear radio emission is usually dominated by a complex distribution of emission with median diameter of 200 pc and median power of 10^{19} W Hz^{-1} sr^{-1} at 1400 MHz. There is a large range in both power and diameter. The power is independent of morphological type for the normal spirals but is correlated with the absolute optical magnitude and with the infrared emission. For Seyfert galaxies the emission is generally stronger, in some cases by several orders of magnitude (e.g. NGC 1275, 3C 120). Elliptical galaxies have been found with very compact radio sources, some less than a parsec in diameter. These are as powerful as the strongest spirals (~10^{21} W Hz^{-1} sr^{-1}). Even stronger compact nuclear sources are now being found in the nuclei of those elliptical galaxies which also have extended radio sources (the radio galaxies). The presence of nuclear sources of this strength is so highly correlated with the presence of extended sources that this suggests a continuing involvement of the nucleus. (auth)

24841 FINE STRUCTURE WITHIN THE REDSHIFT-MAGNITUDE CORRELATION FOR GALAXIES. Tifft, W. G. (Arizona Univ., Tucson (USA)). pp 243-256 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Previous work on the redshift-magnitude banding correlation is briefly reviewed. New tests of the concept are applied successfully to a second cluster (A2199) and the outer portions of the Coma cluster. Using more than 200 redshifts in Coma, Perseus, and A2199 the presence of a distinct band-related-periodicity in redshift is indicated. Finally, a new sample of accurate redshifts of bright Coma galaxies on a single band is presented, which shows a strong redshift periodicity of 220 km s^{-1}. An upper limit of 20 km s^{-1} is placed on the internal Doppler component of motion in the Coma cluster. Redshift-magnitude bands are, therefore, now recognised to consist of discrete "spin states" organized into "spin groups" which show strong morphological associations. Bands are probably in turn organized into band systems. The individual spin states are suggested to represent distinct configurations of matter at the nuclear or fundamental particle structure level. Transitions between states in a time systematic sense of decreasing redshift (increasing internal binding) are suggested to occur in galaxy nuclei. Energy released in such transitions may be the driving energy in radio sources and related objects. (auth)

24842 THE EXTRAGALACTIC RELATIVE DISTANCE SCALE. Abell, G. O. (California Univ., Los Angeles (USA)). pp 225-235 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Arguments are given to support the hypothesis that a characteristic point on a cluster luminosity function, m^*, corresponds to the same absolute magnitude in all clusters, and thus is an appropriate standard candle for determination of relative cluster distances. It is shown, however, that if m^* is a good standard candle, then the first and tenth brightest cluster galaxies, m(1) and m(10), respectively, are not, for $m^* - m(1)$ and $m^* - m(10)$ both differ significantly from cluster to cluster. Moreover, m(1) and especially m(10) depend on cluster richness. Distances derived from them for remote clusters chosen for analysis are thus subject to selection effects that depend on cluster richness and on Bautz-Morgan type. Finally, a procedure suggested by Bautz and Abell is described whereby m^* can be estimated from observed properties of distant clusters. (auth)

24843 HIGH-RESOLUTION STUDIES OF NEUTRAL HYDROGEN IN NGC 5383 AND M101. Allen, R. J.; Goss, W. M.; Sancisi, R.; Sullivan, W. T. III; van Woerden, H. (Rijksuniversiteit Groningen (Netherlands)). pp 425-430 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Maps with 0.5 resolution are presented of the distribution of neutral hydrogen in two galaxies. The barred spiral NGC 5383 contains much hydrogen, in strong differential rotation, in its outer parts; some H I concentrations with possibly anomalous velocities are observed in the regions of bar and nucleus. In the giant Scd spiral M101, the H I distribution corresponds closely with the optical spiral pattern, except for a lack of hydrogen in the central region. (auth)

24844 THE MOTIONS IN THE CENTRAL REGION OF NGC 4736. van der Kruit, P. C. (Hale Observatories, Pasadena, Calif. (USA)). pp 431-437 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Spectroscopic observations of the central part of NGC 4736 show strong noncircular motions connected with the triple radio source. It is also found that a central ring of H II regions is probably expanding at about 30 km s^{-1}. (auth)

24845 STRENGTH OF THE GALACTIC SHOCK WAVE AND THE DEGREE OF DEVELOPMENT OF SPIRAL STRUCTURE. Roberts, W. W. Jr. (Virginia Univ., Charlottesville (USA)); Roberts, M. S. (National Radio Astronomy Observatory, Charlottesville, Va. (USA)); Shu, F. H. (California Univ., Berkeley (USA)). pp 439-441 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

The luminosity of a spiral arm is believed to originate primarily in the very young, newly forming stars; and the spiral arm itself to be a spiral wave which is capable of triggering the formation of the young stars selectively along the wave crest. A semi-empirical study of the density wave patterns predicted in the density wave models of twenty-five external galaxies has been made and one result of this study is presented here. It is found that those galaxies of the sample whose models predict the possibility of strong shock waves are also the galaxies which exhibit long, well-developed spiral arms; and those galaxies whose models predict weak-shock waves are also the galaxies which exhibit less-developed spiral structure. This trend is seen through a correlation between $w_{\perp 0}$, the velocity component of basic rotation normal to a spiral arm, which is an important parameter in determining the shock strength on the one hand, and luminosity class, which is a measure of the degree of development of spiral structure on the other. (auth)

24846 SUPERCLUSTERING OF GALAXIES. Abell, G. O. (California Univ., Los Angeles (USA)). pp 79-92 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Evidence for superclustering of galaxies includes the local supercluster, the large deviation of the observed surface distribution of clusters of galaxies from a random one, the cell size dependence of the index of clumpiness, the results of covariance function tests for correlations between different cluster centers and between clusters and individual galaxies, and a power-spectrum analysis. All tests give results that indicate or are compatible with the existence of inhomogeneities in the distribution of matter in space with linear diameters of 50 to 100 Mpc. If these are dynamically stable superclusters, they probably have internal dispersions in the range 1000 to 3000 kms^{-1}. The possible effects of superclustering on dynamical studies of individual clusters are discussed briefly. (auth)

24847 FIELD GALAXIES AND CLUSTER GALAXIES: ABUNDANCES OF MORPHOLOGICAL TYPES AND CORRESPONDING LUMINOSITY FUNCTIONS. Neyman, J.; Scott, E. L. (California Univ., Berkeley (USA)). pp 129-140 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

With reference to theory published earlier, formulas are given for the estimation of (i) abundances of morphological types among field galaxies, (ii) of selection probabilities, and (iii) of "space luminosity functions". Strictly, the theory applies to "homogeneous classes" of galaxies. This term designates a category of galaxies, say C, so finely defined that the probability, say $\Phi(m|\,C)$, that a galaxy of category C will be included in the catalogue depends on its photographic apparent magnitude m and on nothing else. The practical use of the theory is illustrated on data in the HMS Catalogue. It appears that certain combinations of the Hubble morphological types satisfy the definition of a homogeneous class. Such, for example, is the case for combinations of ellipticals E0-E3 and, separately, of spirals Sc, Scp, SBc. However, the combination of these two categories is not a homogeneous class. In order to validate the theory empirically, calculations were performed to predict the abundances of eight combinations of morphological types among cluster galaxies listed in the HMS Catalogue, each combination being treated as a distinct homogeneous class. Additional hypotheses underlying these calculations are: (a) abundances of morphological types, (b) luminosity functions of these types, and (c) selection probabilities for cluster galaxies with those for field galaxies. A comparison with the observations, reaching the value of $z = 0.07$, is satisfactory. This tends to validate the combination of formulas (i), (ii), (iii) with the additional hypotheses (a), (b) and (c). Incidentally, the result tends to support the steady state cosmology. (auth)

24848 WHIRL THEORY OF THE ORIGIN OF GALAXIES AND CLUSTERS OF GALAXIES. Ozernoy, L. M. (AN SSSR, Moscow. Fizicheskij Inst.). pp 227-240 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

This paper reviews the present state of the theory of primaeval whirls which may be responsible for the origin of galaxies and galaxy systems. The main problems on which the author concentrates are concerned with the pre-recombination evolution of the whirls. Special attention is given to new results, obtained by Kurskov and the author, concerning the dissipation of cosmological turbulence and the constraints which follow on the parameters of primaeval whirls. In contrast to some assertions in the literature, there is no contradiction between the whirl concept and observations. Moreover, the fact that the final spectrum of motions and corresponding inhomogeneities does not depend essentially upon the details of the initial whirl spectrum makes the theory very attractive. The formation of galaxy systems (groups, clusters etc.) is discussed, and alternatives for the formation of galaxies

themselves are briefly outlined. Many aspects of the whirl theory are suitable for further observational and theoretical development. (auth)

24849 FORMATION OF GALAXIES IN FRIEDMANNIAN UNIVERSES. Doroshkevich, A. G.; Sunyaev, R. A.; Zel'dovich, Ya. B. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). pp 213-225 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

A short review of the theory of the formation of galaxies and clusters of galaxies is given within the framework of the non-linear theory of gravitational instability. Probable initial conditions are discussed as well as processes which bring about the origin of galaxies and clusters of galaxies. Possible observational tests are discussed. (auth)

24850 GENERATION OF SOUND FROM PRIMORDIAL COSMIC TURBULENCE. Nariai, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). pp 241-243 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

From the standpoint of the turbulent origin of the formation of galaxies, it is important whether the primordial cosmic turbulence can survive up to the necessary epoch against acoustic decay. This is a preliminary report of a new formalism for attacking the problem. (auth)

24851 OBSERVATIONAL EVIDENCE FOR NON-VELOCITY REDSHIFT IN STEPHANS QUINTET. Balkowski, C.; Bottinelli, L.; Chamaraux, P.; Gouguenheim, L.; Heidann, J. (Observatoire de Paris). pp 237-242 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed. by Dordrechf, Netherlands); Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Distance determinations of the high-redshift galaxy NGC 7319 in Stephan's Quintet, based on 21-cm line observations, yield a value much smaller than the cosmological distance. At the 98.7% level, a part of the redshift of this galaxy which could amount to 5000 km s^{-1} is anomalous. (auth)

24852 RECENT WESTERBORK OBSERVATIONS OF HEAD-TAIL GALAXIES. Miley, G. K.; van der Laan, H.; Wellington, K. J. (Sterrewacht, Leiden, The Netherlands). pp 109-118 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Some recent observations of head-tail galaxies are presented. All the data are consistent with the hypothesis that the galaxies are active radio sources and that the tails are merely trails left behind as these galaxies plough through a dense intra-cluster medium (Miley et al., 1972). (auth)

24853 STRUCTURE DYNAMICS AND STATISTICAL PROPERTIES OF GALAXIES. De Vaucouleurs, G. (Texas Univ., Austin (USA)). pp 1-53 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

The following empirical or physical parameters describing individual and statistical properties of galaxies are reviewed: morphological type including new or revised types; intrinsic luminosity distribution functions of two main components (spheroid and disk); true ellipticities of different types; characteristic scale parameters (effective diameter and luminosity density) of spheroidal and flat systems; masses and densities of spheroidal, disk and mixed systems from velocity dispersion and rotation velocities; rotation periods, maximum rotation velocities, angular velocities and momenta of different types; neutral hydrogen masses and densities; spectral energy distributions and colour indices; number of independent parameters from principal component (factor) analysis; luminosity functions and selection effects; clustering and space distribution; maximum density-radius and velocity dispersion-radius relations in systems of galaxies. (auth)

24854 PROPERTIES AND DISTRIBUTION OF GALAXIES IN RELATION TO THEIR FORMATION AND EVOLUTION: THEORETICAL SITUATION. Peebles, P. J. E. (California Univ., Berkeley (USA). Dept. of Physics). pp 55-74 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Several proposed pictures for how matter came to be concentrated in lumps like galaxies and clusters of galaxies are reviewed. The proposals cover a broad range of unrelated possibilities. An attempt is made to subject these proposals to critical discussion, to discover the major problems for each case and the more promising lines for further study. (auth)

24855 DISTRIBUTION OF GALAXIES IN RELATION TO THEIR FORMATION AND EVOLUTION. Peterson, B. A. (Australian National Univ., Canberra. Mount Stromlo and Siding Spring Observatories). pp 75-84 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

The distribution of galaxies on the sky is not random, but has structure on a scale of ~30 Mpc. Similar structure in the cosmic background radiation is not present. Another expected source of structure in the background radiation is the finite size of the light horizon in the early Universe. The lack of observable structure in the background radiation implies extreme initial isotropy, and for the initial perturbations from which galaxies and clusters of galaxies formed. (auth)

24856 DYNAMICS OF SUPERCLUSTERS AS THE MOST POWERFUL TEST FOR THEORIES OF GALAXY FORMATION. Ozernoy, L. M. (AN SSSR, Moscow. Fizicheskij Inst.). pp 85-91 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Analysis of Brown's (1964, 1968) data on the orientation of galaxies inside superclusters confirms his conclusion that the directions of the major axes of the galaxies are significantly correlated. For a number of super-clusters, the minor axes are found to be oriented along the direction of the flattening of the supercluster as a whole. By analogy with the Local Supercluster where the same phenomenon is associated presumably with the rotation established by de Vaucouleurs (1959), one may conclude that, in general, superclusters rotate. It is shown that rotation on scales as large as these cannot be explained by tidal or by any local effects and must have a primeval nature analogous to the 3 K microwave background. Rotation on such scales contradicts the standard idea of galaxy formation from density fluctuations but favours the concept of primeval whirls which gave rise to pregalactic density inhomogeneities. (auth)

24857 INTERGALACTIC MATTER AND RADIATION AND ITS BEARING ON GALAXY FORMATION AND EVOLUTION. Burbidge, G. R. (California Univ., La Jolla, San Diego (USA). Dept. of Physics). pp 93-108 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

An up-dated review is given of the evidence for the presence of intergalactic matter and radiation in the Universe. It is concluded that the only important constituents which may make a sizeable contribution to the total mass-energy are intergalactic gas and condensed objects with a very high mass-to-light ratio. If the QSOs are not at cosmological distances, cold atomic hydrogen may still be the most important constituent and may contribute much more mass than do the galaxies. The X-ray observations still do not unambiguously show that very hot gas is present, though it is very likely on general grounds that some hot gas is present in clusters of galaxies. The question of whether or not large amounts of matter, enough to close the Universe, are present, remains unsettled. From the theoretical standpoint the answer depends almost completely on the approach taken to the problem of galaxy formation and to the cosmological model which is favoured. (auth)

24858 EARLY HISTORY OF OUR GALAXY: DYNAMICS. Freeman, K. C. (Australian National Univ., Canberra. Mount Stromlo and Siding Spring Observatories). pp 129-137 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Dynamical aspects of the early history of our Galaxy are discussed, with emphasis on the two-component nature of disk galaxies. Topics include the Eggen, Lynden-Bell and Sandage picture of the Galaxy's collapse, dynamical problems of the disk, and the bulge component. (auth)

24859 DISTRIBUTION OF MASS-TO-LIGHT RATIO WITH RADIUS IN M31 AND M33. Baldwin, J. E. (Cambridge Univ. (UK). Cavendish Lab.). pp 239-140 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

New H I observations indicate that the mass-to-light ratios in the disks of M31 and M33 are independent of radius. The results for these two galaxies suggest that the constancy of the M/L ratio may be a common property of the disks of spiral galaxies. (auth)

24860 EARLY HISTORY OF OUR GALAXY: CHEMICAL EVOLUTION. Peimbert, M. (Universidad Nacional Autonoma de Mexico, Mexico City). pp 141-156 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

A general review is given of chemical abundance determinations; particular emphasis is given to abundances of galactic and extragalactic metal-poor objects since presumably they represent the abundances of the primeval material from which our Galaxy was formed. The following results are stressed: most of the helium present in the galaxies of the local group as well as in other galaxies was produced before these objects were formed, the heavy elements were produced mainly as the result of stellar evolution, there is a chemical abundance gradient in our Galaxy and, by analogy with other galaxies, it is expected to be steeper near the nucleus, the carbon and oxygen content of our Galaxy increased at a rate different from the metals, reaching their present abundance earlier than the other heavy elements, and the increase of the iron abundance in the disk of our Galaxy with time has been small while that of carbon is negligible; furthermore, as a group the supermetal-rich stars correspond to the old disk population. Several models of galactic chemical evolution are reviewed. (auth)

24861 DIFFERENCES BETWEEN GALAXIES. Van den Bergh, S. (Toronto Univ., Ontario (Canada)). pp 157-168 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

It is pointed out that the metallicity of galactic and extragalactic globular clusters correlates with the density of the regions in which they were formed. Within individual galaxies the regions of highest density have the highest metallicity. Some of the differences in family traits between the globulars in the Andromeda Nebula, the Galaxy and the Magellanic Clouds might be understood if the M31 cluster system is $\sim 1 \times 10^9$ yr older and the SMC cluster system $\sim 1 \times 10^9$ yr younger than galactic globular clusters. (auth)

24862 DWARF CONTENT OF OLD GALAXY POPULATIONS. Whitford, A. E. (California Univ., Santa Cruz (USA). Lick Observatory). pp 169-172 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Scanner observations of five galaxies in the region near 9910 Å showed that the strength of the dwarf-sensitive Wing-Ford band is below the level of detection. This result is at variance with the predictions of strongly dwarf-enriched population models and in accord with the evidence for giant-dominated radiation at 2.3μ reported by Baldwin et al. (1973) on the basis of the strong CO band found in three galaxies. In the absence of any evidence for a power-law mass function, the consequences of a rounded function are examined. (auth)

24863 FORMATION OF DISKS BY INELASTIC COLLISIONS OF GRAVITATING PARTICLES. Applications to the Formation of Galaxies. Brahic, A. (Observatoire de Paris, Section de Meudon, 92 (France)). pp 173-179 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

The numerical study of a gravitating system of colliding particles has many potential applications, for instance the formation of flat galaxies, the formation of the solar system and the evolution of Saturn's rings. Preliminary results are presented for the galactic case. The system tends towards a final equilibrium state and it seems that such a collision mechanism can flatten a protogalaxy. (auth)

24864 NEUTRAL HYDROGEN AT LARGE DISTANCES FROM PARENT GALAXIES. Davies, R. D. (Nuffield Radio Astronomy Labs., Jodrell Bank (UK)). pp 119-128 of Formation and Dynamics of Galaxies. Shakeshaft, J. R. (ed.). Dordrecht, Netherlands; Reidel (1974).

From symposium on the formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

High sensitivity measurements in the vicinity of nearby galaxies have shown the existence of appreciable quantities of neutral hydrogen at large distances (2 to 5 Holmberg radii) from the center. The galaxies studied were the M81/M82/NGC 3077 system, M31, M33, IC 342 and M51. In all cases the gas is at velocities consistent with being bound to the parent galaxy. Of these the M81 system contains the most cirum-galactic neutral hydrogen. In several galaxies there is as much neutral hydrogen outside the Holmberg dimensions as inside. (auth)

Cosmology

Refer also to abstracts 24763–24765, 24779, 24780, 24846, 24847, 24850, 25008, and 25212.

24865 CONFRONTATION OF ANTIMATTER COSMOLOGIES WITH OBSERVATIONAL DATA. Steigman, G. (Yale Univ., New Haven, Conn. (USA)). pp 347-356 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

The presence of large amounts of antimatter in the Universe would be detectable directly via the cosmic rays and indirectly via the annihilation γ-rays. The observational data is reviewed. There is no evidence whatever indicating the presence of astrophysically interesting amounts of antimatter in the Universe. From the available data it may be concluded that the Galaxy is made entirely of ordinary matter and that if any antimatter at all is present in the Universe, it must be very well separated from ordinary matter. Furthermore, it is shown that the observational constraints on various symmetrical cosmological models strengthen the case against antimatter in the Universe. (auth)

24866 SINGULARITIES IN COSMOLOGY. Penrose, R. (Oxford Univ. (UK). Mathematical Inst.). pp 263-272 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Singularities in space-time can be broadly divided into three classes: past-spacelike (in white holes or the big bang), timelike (naked singularities) and future-spacelike (in black holes or the final recollapse). In a closed Universe, if a simple restriction is made to eliminate timelike singularities, the inference may be drawn that the topology of the Universe is unchanging with time. Thermodynamical considerations lead one to infer that the final singularity of recollapse must differ markedly in structure from the initial big bang. This may plausibly be related to the existence of black holes and the presumed non-existence of white holes. (auth)

24867 ISOTROPIZATION OF HOMOGENEOUS COSMOLOGICAL MODELS. Novikov, I. D. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). pp 273-282 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Observations primarily of the microwave background radiation show that the Universe expands isotropically with degree of accuracy at the present time and that the matter distribution is homogeneous on a large scale. Thus, the Friedmann cosmological models are a good approximation today for the expanding Universe. This is valid for at least some period of time in the past too. But how did the Universe expand and what was the matter distribution close to the starting point, near the cosmological singularity? A tentative conclusion is drawn that the expansion was isotropized very early at $t \sim t_{Planck} \sim 10^{-43}$ S. (auth)

24868 ANISOTROPY OF THE UNIVERSE AT LARGE TIMES. Hawking, S. W. (Cambridge Univ. (UK). Inst. of Theoretical Astronomy). pp 283-286 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

The behaviour of small perturbations is analysed from a Friedmann model and the anisotropy they would produce in the background radiation is calculated. It is concluded that the Universe must be nearly isotropic at the present time, and that this isotropy is a result of the fact that the Universe is expanding at just about the critical rate to avoid recollapse. (NL)

24869 LARGE NUMBER COINCIDENCES AND THE ANTHROPIC PRINCIPLE IN COSMOLOGY. Carter, B. (Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical

Physics). pp 291-298 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

In Bondi's (1959) book Cosmology certain widely known "large number coincidences" are listed as evidence justifying the introduction of various exotic theories (e.g. involving departures from normally accepted physical conservation laws) of which early examples were the "varying G" theories of Dirac and Jordan. The author is convinced of the opposite thesis: i.e. that far from being evidence in favour of exotic theories these coincidences should rather be considered as confirming "conventional" (General Relativistic Big Bang) physics and cosmology which could in principle have been used to predict them all in advance of their observation. However these predictions do require the use of what may be termed the anthropic principle to the effect that what is observed must be restricted by the conditions necessary for presence as observers. (auth)

24870 LOW FREQUENCY GRAVITATIONAL WAVES IN COSMOLOGY. Dautcourt, G. (Akademie der Wissenschaften der DDR, Potsdam. Zentralinstitut fuer Astrophysik). pp 299-315 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

An intense non-thermal background of cosmic gravitational radiation in the Megaparsec wave band could be detected by its influence on many astrophysical processes. In particular, it may give an explanation of the so-called redshift anomalies. (auth)

24871 QUANTUM DESCRIPTIONS OF SINGULARITIES LEADING TO PAIR CREATION. Misner, C. W. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). pp 319-327 of Confrontation of Cosmological Theories with observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Inhomogeneous generalizations of the Kasner cosmological models have been found by Gowdy, and can be used to exhibit simplified models of quantized gravitational fields. One finds that a quantum description can be given arbitrarily near the singularity. Graviton pair creation occurs, and can be seen to convert anisotropic expansion rates into the energy of graviton pairs. (auth)

24872 CREATION OF PARTICLES IN COSMOLOGY. Zel'dovich, Ya. B. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). pp 329-333 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

The creation of particles is a process which can only be described by quantum field theory. The creation of particles may influence the cosmological equations through the energy-stress tensor of these particles. For physical cosmology the particles themselves are important. The new approach to quantum corrections, developed in this report, is equivalent to introducing viscosity into space-time. The additional energy-stress components are proportional to time derivatives of the curvature. (auth)

24873 BARYON SYMMETRIC BIG BANG COSMOLOGY. Omnes, R. (Paris-11 Univ., 91-Orsay (France). Lab. de Physique Theorique et Hautes Energies); Puget, J. L. (Observatoire de Paris, Section de Meudon, 92 (France)). pp 335-339 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

In a big bang cosmology in which the Universe is initially filled with thermal radiation at a very high temperature the number of nucleon-antinucleon pairs decreases exponentially with temperature when the latter falls below a value such that $\kappa T \sim 1$ GeV. To explain the observed ratio $\eta = N/N_{ph} \sim 10^{-9}$ where N is the average baryon density and N_{ph} the photon density, nucleons and antinucleons must have been separated in the thermal radiation at a temperature greater than 30 MeV. A mechanism has been suggested which would lead to a phase transition in thermal radiation for $\kappa T > 300$ MeV resulting in two phases with opposite non zero baryon number. The interaction between nucleons and antinucleons at intermediate energy is repulsive according to the mesonic theory of nuclear forces. This can be checked experimentally by measuring with enough precision the energy of X-rays emitted by the protonium atom and this experiment is now under way at CERN. Different models have been made to investigate their consequences and in each case a phase transition has been found above a temperature of the order of 300 MeV. (auth)

24874 LOW DENSITY SYMMETRIC COSMOLOGY. Elvius, A. (Stockholm Observatory, Saltsjoebaden, Sweden); Karlson, E. T. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik); Laurent, B. E. (Stockholm Univ. (Sweden). Fysiska Institutionen). pp 341-345 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Most cosmological models are based on the "cosmological principle" according to which the Universe is homogeneous and isotropic on a certain level, chosen such that the present mean density is of the order of $10^{-30\pm1}$ g cm^{-3}. These (expanding) models show a density singularity (or at least a very high density) at some early time. To make an approach in which only well known natural laws are applied, an inhomogeneous model like the isolated metagalactic system with much lower density outside than inside is needed. Such a system does not comprise the entire universe but contains all the objects that have been observed. (auth)

24875 ENERGY DENSITY OF THE RELIC RADIATION. Blair, A. G. (Los Alamos Scientific Lab., N. Mex. (USA)). pp 143-155 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Experimental measurements of the intensity of the submillimeter background are reviewed. The latest results all indicate a low background; it is not yet possible to say whether or not the spectrum in this range is blackbody. (auth)

24876 LARGE SCALE ANISOTROPY OF THE COSMIC MICROWAVE BACKGROUND. Partridge, R. B. (Haverford Coll., Pa. (USA)). pp 157-162 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

It is now generally accepted that the microwave background radiation, discovered in 1965 (Penzias and Wilson, 1965; Dicke et al., 1965), is cosmological in origin. Possible anisotropies, or variations in the intensity, of the radiation on a large angular scale are discussed. The kinds of anisotropies to be expected, present experimental results, and some difficulties with these results are described. (auth)

24877 FINE-SCALE ANISOTROPY OF THE COSMIC MICROWAVE BACKGROUND RADIATION. Boynton, P. E. (Washington Univ., Seattle (USA)). pp 163-166 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

A short review of observational upper limits on the amplitude of intensity fluctuations in the microwave background radiation on angular scales of less than one degree is given. These fluctuations are presently of interest for at least two important cosmological concerns: perturbations on the relic radiation and discrete source effects. (auth)

24878 THERMAL HISTORY OF THE UNIVERSE AND THE SPECTRUM OF RELIC RADIATION. Sunyaev, R. A. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). pp 167-173 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Many of the cosmological models currently under discussion and theories of the origin of galaxies which involve antimatter, strong turbulence and so on result in significant energy release during the evolution of the Universe. It is evident that significant energy production should lead to distortions of the spectrum of the relic radiation. The absence of noticeable deviations from the Planckian spectrum enables limits to be set on the energy release in the early Universe ($10^2 < z < 10^8$). (auth)

24879 THE SPECTRUM OF DENSITY PERTURBATIONS IN AN EXPANDING UNIVERSE. Silk, J. (California Univ., Berkeley (USA)). pp 175-193 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Perhaps the most challenging problem confronting a cosmologist is to reconcile the observed large-scale structure of the Universe with the Friedmann–Lemaitre cosmological models that have gained such widespread acceptance in recent years. The spectrum of density inhomogeneities that survive decoupling of matter and radiation at $z \sim 1000$ and provide the primordial fluctuations that can eventually generate galaxies is considered. (auth)

24880 COSMOLOGICAL SYNTHESIS OF THE ELEMENTS. Wagoner, R. V. (Cornell Univ., Ithaca, N. Y. (USA). Center for Radiophysics and Space Research). pp 195-210 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

The results of improved calculations of the abundances of the nuclei produced in big-bang models of the early universe are presented. In addition to the standard model, other possible universes are considered, including the recent statistical bootstrap theory of Carlitz, Frautschi, and Nahm. Some conclusions which can be drawn about the nature of the early universe, depending upon whether the observed deuterium and helium are of galactic or cosmological origin, are presented. (auth)

24881 OBSERVATIONAL FOUNDATIONS FOR ASSUMPTIONS IN COSMOLOGY. Heller, M.; Klimek, Z.; Rudnicki, K. (Uniwersytet Jagiellonski, Krakow (Poland). Obserwatorium Astronomiczne). pp 3-11 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Testing cosmological models is worthwhile as long as the theoretical assumptions, on which these models are based, are true. Observational material testing the Cosmological Principle separately for geometry and substratum, is discussed without referring to any given model of the Universe. (auth)

24882 INTERGALACTIC GAS. Field, G. B. (Harvard Coll. Observatory, Cambridge, Mass. (USA)). pp 13-30 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Evidence that rich clusters of galaxies contain hot ($T = 10^8$K) intracluster gas is reviewed. Such gas contributes little to $\Omega(0.003)$ but it has been argued that Ω must be less than 0.05 for true intergalactic gas, if accretion of more gas than is observed in rich clusters is to be avoided. This argument is reviewed. If the de Vaucouleurs' groups are bound by intracluster gas, T is expected to be 10^5 to 10^7K and the contribution to Ω is $\simeq 1$. Since the clumping factor C is estimated to be $\simeq 7$, the resulting value of $\Omega^2 C$ is $\simeq 7$. This does not violate the observed diffuse soft X-ray background intensity. Gas should be sought in such groups. Smoothly distributed gas with $10^7 < T < 3 \times 10^8$K and $\Omega = 1$ is not ruled out by direct observations. (auth)

24883 CONFRONTATION OF LEMAITRE MODELS AND THE COSMOLOGICAL CONSTANT WITH OBSERVATIONS. Petrosian, V. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). pp 31-46 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

The history of the cosmological constant and the Lemaitre models is reviewed briefly. Using recent cosmological observations, it is found that the cosmological constant if non-zero must be in absolute value less than 2×10^{-56} cm^{-2}. The predictions of the Lemaitre models are compared with modern observations. It is shown that Lemaitre models without evolution fail to reproduce the observed radio source counts. The existence of quasars with large redshift ($z > 2.5$) is shown to be strong evidence against the Lemaitre models. (auth)

24884 HUBBLE CONSTANT AND THE DECELERATION PARAMETER. Tammann, G. A. (Basel Univ. (Switzerland)). pp 47-59 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

A preliminary report is given of recent work with A. Sandage on the Hubble constant. Through a chain of distance indicators in Sc and Ir galaxies (cepheids, brightest stars, H II regions, and luminosity classes) the distance scale is carried beyond any possible local anisotropy of the velocity field. Special care is taken to allow for the dependence of the intrinsic properties of the distance indicators on the size of the parent galaxy, and for the effect of the Malmquist correction. H_0 is found to be 55 ± 7 kms^{-1} Mpc^{-1}; within the errors no systematic changes with distance were found. A formal value of the deceleration constant $q_0 = 1 \pm 1$ was recently derived by Sandage (1972a) and Sandage and Hardy (1973). The most important correction to this value is probably the luminosity evolution of galaxies, which tends to push q_0 below 0.5. The ensuing evidence for an open universe is also favored by independent arguments. (auth)

24885 EVIDENCE FOR NON-VELOCITY REDSHIFTS. Arp, H. (Hale Observatories, Pasadena, Calif. (USA)). pp 61-67 of Confrontation of Cosmological Theories with Observational Data. Longair, M. S. (ed.). Dordrecht, The Netherlands; Reidel (1974).

From symposium on confrontation of cosmological theories with observational data; Cracow, Poland (10 Sep 1973).

Evidence for non-cosmological redshifts is reviewed. It is shown that all current statistical tests favor association of QSRs with galaxies close by, in distance, to our own. It is possible that all QSRs originate from galaxies of much lower redshift. It is shown that in the four cases where QSRs fall projected closest to bright galaxies, that in all four cases the galaxies show evidence of physical interaction. Evidence for high redshift, compact and peculiar companion galaxies is reviewed. From the individual associations of high redshift QSRs and companions, an empirical continuity of observed characteristics is shown between compactness (youth) and excess redshift. Some theoretical explanations for intrinsic redshifts are mentioned. (auth)

24886 SENSITIVITY OF GRAVITATIONAL DETECTORS WITH PASSIVE CONVERTERS. Braginskii, V. B.; Rudenko, V. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 168-176 (1974). (In Russian).

Gravitational antennas with converters of the piezostriction or magnetostriction type are examined. The actual sensitivity of the antenna is analyzed with a consideration of the inverse effect of the recording installation and formulation of the conditions guaranteeing an approach to achievement of the potential sensitivity of the detector. (JSR)

24887 OPTIMUM PROCESSING OF THE OUTPUT SIGNALS OF GRAVITATIONAL DETECTORS. Loza, N. D.; Rudenko, V. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 176-183 (1974). (In Russian).

The time effects on gravitational detectors of the quadrupole oscillator type are much less than the time of their transient processes. This fact produces some specific singularities in the system of extracting signals from the inherent noise of the antennas. Equations describing these singularities are derived. (JSR)

24888 STATISTICAL ANALYSIS OF THE OUTPUT SIGNALS OF GRAVITATIONAL DETECTORS. Gusev, A. V.; Rudenko, V. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 183-192 (1974). (In Russian).

Specific recommendations are made for the statistical analysis of the output signals of a gravitational detector considered as a Brownian oscillator. The consistency of the hypothetical and observed static output noise of the detector is proven. The conditions for the observation of the signal in the form of a sequence of infrequent random pulses are derived. The cross correlation method of statistical analysis is described. (JSR)

24889 NEUTRINO IN THE FREIDMAN UNIVERSE. Chernikov, N. A.; Shavokhina, N. S. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 154-162(1974). (In Russian).

Equations are derived to show that the behavior of the neutrino in the Freidman universe is conform-invariant. (JSR)

24890 RECORDING OF PULSES OF GRAVITATIONAL BREMSSTRAHLUNG FROM AGGREGATES OF HIGH-DENSITY STARS. Panov, V. I.; Rudenko, V. N. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 221: No. 3, 573-576(21 Mar 1975). (In Russian).

A mathematical development of the subject shows that construction of antennas for recording gravitational bremsstrahlung depends on the development of counters with converters to transform mechanical oscillations of the detectors to electrical signals with a low level of inherent noise and small inertia. There are no serious prohibitions, but there are technical difficulties related to the need for optimum measurement strategies. (2 figures, 1 table) (TTT)

24891 COSMOLOGICAL DEDUCTION OF THE ORDER OF MAGNITUDE OF AN ELEMENTARY-PARTICLE MASS AND OF THE COSMOLOGICAL COINCIDENCES. Landsberg, P. T.;

Bishop, N. T. (Southampton Univ. (UK)). Phys. Lett., A; 53: No. 2, 109-110(2 Jun 1975).

The assumptions adopted here include a time-dependent gravitational constant G, with H/G time-independent, H being Hubble's parameter. In terms of ħ,c,H,G, which are assumed given, the order of magnitude of an elementary particle mass and the cosmological coincidences, using dimensional considerations are deduced. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

24892 ELF/VLF EMISSIONS OBSERVED ON ARIEL 4. Bullough, K.; Denby, M.; Gibbons, W.; Hughes, A. R. W.; Kaiser, T. R.; Tatnall, A. R. L. Univ. of Sheffield, Eng. Proc. R. Soc. (London), Ser. A; 343: No. 1633, 207-226(29 Apr 1975).

The Ariel 4 satellite was designed to study wave-particle phenomena in the magnetosphere by measuring the electromagnetic wave fields over a wide frequency range and the fluxes and pitch angle distributions of energetic particles. The results of a preliminary study of the various v.l.f./e.l.f. electromagnetic wave phenomena which are observed are described. These include man-made signals from v.l.f. transmitters, impulsive noise originating in thunderstorms and emissions arising from magnetospheric energetic charged particles. (auth)

Magnetospheric Phenomena

24893 SOME FUNDAMENTAL IDEAS AND METHODS OF THE THEORY OF MATHEMATICAL INTERPRETATION OF GRAVITATIONAL AND MAGNETIC ANOMALIES. Strakhov, V. N. (Institut Fiziki Zemli, Moscow). Geofiz. Sb.; No. 62, 29-44(1974). (In Russian).

The theory of interpreting gravitational and magnetic anomalies still lacks broad generalizing concepts without which no infrastructure of automated geophysical-data processing systems can be developed, nor any significant process made. In view of this, some relevant methodological aspects of interpretation theory that are basic for the development of generalizing concepts are discussed. A concept of significance to linear analysis of potential fields (gravitational and magnetic anomalies) is formulated. (IAA)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 24232 and 25170.

24894 (INIS-mf-1758) STUDIES OF ATOMIC COLLISIONS IN SOLIDS BY MEANS OF CALORIMETRIC TECHNIQUES. Andersen, H. H. (Aarhus Univ. (Denmark). Matematisk Inst.). Oct 1974. 279p. INIS.

Results of the application of the calorimetric technique to measure the way in which the energy of particles passed through a thin foil and stopped within a solid block is distributed between the foil and the block are presented. This measurement gives the relative energy loss of the projectile in the foil and hence, since the foil thickness is measured independently, the stopping power. Calorimetric methods also allow accurate dosimetry of radiation damage measurements, and can be used to investigate the total energy reflected from a solid surface during heavy-ion bombardment. (INIS)

24895 QUANTUM THEORY OF DECHANNELING: INFLUENCE OF LATTICE VIBRATIONS. Kashlev, Yu. A. (AN SSSR, Moscow. Inst. Metallurgii). Phys. Lett., A; 53: No. 3, 219-220(16 Jun 1975).

A formulation of dechanneling is treated on the basis of the quantum theory of transport phenomena. Phonon scattering by the channeled particle is taken into account. (auth)

24896 MAXIMUM RANGE OF AXIAL CHANNELLED IONS. Krimmel, E. F. (Siemens A. G., Muenchen (F. R. Germany). Forschungslaboratorium). Phys. Lett., A; 53: No. 3, 231-232 (16 Jun 1975).

The maximum range of axial channelled particles can be calculated assuming energy loss in quanta of $\Delta E = h\nu$. The model gives the dependence on particle energy, geometrical cross sections and effective atomic numbers in accordance with experimental data already known. (auth)

24897 GEOMETRICAL ABERRATION OF THE COMBINATION OF ASYMMETRICALLY FED QUADRUPOLE LENSES AND MAGNETIC SECTORS. Szabo, G. (Magyar Tudomanyos Akademia Atommag Kutato Intezete, Debrecen). Nucl. Instrum. Methods; 125: No. 3, 339-343(15 Apr 1975).

"Spherical"-type aberrations of systems consisting of sectors with homogeneous field and quadrupole lenses with asymmetrized feeding were investigated. In the analytical examinations the aberration of the quadrupoles was considered in "weak-lens" approximation. It was shown that the aberration of the system can be decreased with the asymmetrization of the quadrupole lens. This result was proved by numerical calculations carried out for the "rectangular model". It is pointed out that it is possible to apply the asymmetrization in energy and mass spectrometers in order to improve the resolution of the system. (auth)

24898 SCALING LAWS FOR HIGH-CURRENT H^- MAGNETRON ION SOURCES. Green, T. S. (UKAEA Research Group, Abingdon, Culham Lab.). Nucl. Instrum. Methods; 125: No. 3, 345-348(15 Apr 1975).

High-current negative hydrogen beams (~1A) have recently been produced by direct extraction from magnetron (or planotron) ion sources. These sources are limited, however, to short pulse durations by the higher power densities at which they operate. In this paper, consideration is given to the scaling laws for these sources, in order to examine the possibility of operation at lower power densities for longer periods. The laws derived are based on (a) the calculation of the effect of the magnetic field on the motion of ions in the source and of electrons in the extraction gap, (b) calculation of the rate of negative-ion production by positive ion flux to the cathode and attenuation of negative ions traversing the source by ions and electrons in the source plasma. (auth)

24899 VIBRATIONAL ENERGY TRANSFER IN NON-REACTIVE MOLECULAR COLLISIONS: AN INFORMATION-THEORETIC ANALYSIS. Procaccia, I.; Levine, R. D. (Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry). Chem. Phys. Lett.; 33: No. 1, 5-10(15 May 1975).

Experimental and (trajectory) computed rates of vibrational relaxation of molecules in selected internal states are analyzed. A dynamic constraint is identified. The entire array of (vibrational) manifold-to-manifold rate constants (at a given temperature) is shown to be characterized by this constraint and hence yield a linear surprisal plot. It is argued that bulk measurements of the vibrational relaxation time in a buffer gas will suffice to determine the single parameter in the dynamic constraint. (auth)

24900 SCATTERING OF A DIATOMIC MOLECULE BY A STATIONARY SURFACE. Goodman, F. O. (Waterloo Univ., Ontario (Canada). Dept. of Applied Mathematics); Liu, W. S. (Toronto Univ., Ontario (Canada). Inst. for Aerospace Studies). Surf. Sci.; 49: No. 2, 417-432(Apr 1975).

The CCGM [N. Cabrera, V. Celli, F. O. Goodman and R. Manson, Surface Sci. 19 (1970) 67] theory of elastic scattering (diffraction) of atoms by surfaces is generalized to the case of scattering of diatomic molecules. No extensive applications of the theory are made, but an example considered by R. M. Logan [Mol. Phys. 17 (1969) 147] of the scattering of a low-energy beam of H_2 by a cold surface is re-examined in the context of the new theory. It is concluded that, because of the uncertainties in the form of the molecule-surface interaction potential and in the values of the interaction parameters, no quantitative reliance can be placed on calculations of molecule-surface scattering probabilities at the present time. Future comparisons with experimental data should help to reduce these uncertainties. (auth)

24901 ATOM-SURFACE SCATTERING WITH VELOCITY-SELECTED H AND D ATOMIC BEAMS FROM LiF AND NaF (001). Finzel, H.-U.; Frank, H.; Hoinkes, H.; Luschka, M.; Nahr, H.; Wilsch, H.; Wonka, U. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany)). Surf. Sci.; 49: No. 2, 577-605 (Apr 1975).

Hydrogen and deuterium atoms with an energy between 20 and 140 MeV have been scattered from LiF and NaF (001) cleavage planes in UHV. The atomic beam was nearly monoenergetic by use of a slotted disk type velocity selector with a velocity resolution of $\Delta v/v = 12\%$ (FWHM). The scattering showed diffraction with a pronounced specular beam. The energies of several bound surface states have been determined by analysis of selective adsorption minima. These energies together with relative intensities of diffracted beams and specular intensity versus incident energy measurements may be represented by an interaction potential of Morse-type with additional terms which are periodic parallel to the surface. The parameters of the Morse-potential have been found to be: depth D = 17.8 meV and reciprocal range $\kappa = 1.04$ Å^{-1} for H_1/LiF (001) and D = 17.9 meV, $\kappa = 1.15$ Å^{-1} for H_1/NaF (001); the additional periodic terms have relative strength $\beta_{10} = 0.04$ and $B_{11} \sim B_{10}/2$ in the case of H_1LiF, but $\beta_{11} \sim \beta_{10} = 0.03$ in the case of H_1/NaF. From the observed influence of surface influence of surface temperature on the position of selective adsorption minima the coefficient of thermal expansion of the topmost surface layer turns out to be approximately twice the bulk value. (auth)

Atomic and Molecular Properties

Refer also to abstracts 24188 and 24913.

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

24902 (JINR-D1-8876) STUDY OF THE NEGATIVE PION TRANSFER TO CARBON ATOMS IN ORGANIC MOLECULES. Petrukhin, V. I.; Risin, V. E.; Samenkova, I. F.; Suvorov, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 15p. Dep. NTIS (US Sales Only) $4.00.

A difference is observed between the rates of negative pion transfer to carbon atoms of organic molecules in the saturated aliaphatic series C_mH_n and in mixed gases $H_2 + C_mH_n$. This difference is shown to be originated in the different excitation energies of hydrogen mesoatoms formed in free hydrogen (H_2) and in chemically bound one (C_mH_n). Neither the grouping of atoms Z in the molecules, nor their encirclement by hydrogen atoms, nor the particular properties of the chemical bond among Z atoms seem to have any effect on the transfer process. (auth)

24903 (JINR-P4-8884) CONTINUOUS ANALOG OF NEWTON'S METHOD FOR FINDING OF THE QUASISTATIONARY SOLUTIONS OF THE SCHROEDINGER EQUATION. Ponomarev, L. I.; Puzynin, I. V.; Puzynina, T. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 31p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

The method for solving the system of the Schroedinger equations (CAMEN- scheme) is suggested and realized. The method is applied for determining the energy and wave functions of quasi-

stationary states of hydrogen mesonic molecules. The convergence and stability of the method are studied. (auth)

24904 DRIFT OF THE MOMENTUM DISTRIBUTION OF ANNIHILATING PAIRS e^+e^- IN Na, Cu, AND Zn SAMPLES CONDUCTING ELECTRIC CURRENT. Rozenfeld, B.; Baranowski, A.; Jerie, K. (Wroclaw Univ. (Poland)). Phys. Lett., A; 53: No. 2, 154-156(2 Jun 1975).

Evidence is presented of the influence of the current carrier mobility on the angular correlation of the annihilation quanta in polycrystalline samples of Na, Cu, and Zn conducting electric current. (auth)

Collision Phenomena

Refer also to abstracts 24918 and 25074.

24905 GLAUBER THEORY OF ATOMIC HELIUM IONIZATION BY ELECTRON IMPACT. Mohan, M.; Vidhani, T. (Delhi Univ. (India). Dept. of Physics and Astrophysics). Phys. Lett., A; 53: No. 3, 245-246(16 Jun 1975).

Glauber scattering amplitude is expressed in the form of a one-dimensional integral in terms of Meijer G-functions. This may further be expressed in a closed form by using the series representation for Meijer function. (auth)

24906 COLLINEAR QUANTUM MECHANICAL CALCULATIONS FOR THE REACTION $He + H_2^+ \rightarrow HeH^+ + H$. Adams, J. T. (Rice Univ., Houston, Tex. (USA). Dept. of Chemistry). Chem. Phys. Lett.; 33: No. 2, 275-278(1 Jun 1975).

An integral equation reaction path technique has been used to calculate, within the collinear approximation, reaction probabilities for the reaction $He + H_2^+ \rightarrow HeH^+ + H$ over the energy range $0.95 \leq E \leq 1.19$ eV. This reaction differs from those that have been studied previously within the collinear approximation in that a severe oscillatory behavior is exhibited in the energy dependence of the reaction probabilities. (auth)

24907 MECHANISM OF THE $He^+ + N_2$ THERMAL ENERGY DISSOCIATIVE CHARGE TRANSFER REACTION. Marx, R.; Mauclaire, G.; Fenistein, S. (Paris-11 Univ., 91-Orsay (France)). Chem. Phys. Lett.; 33: No. 2, 357-361(1 Jun 1975).

ICR spectroscopy has been used to reinvestigate the $He^+ + N_2$ charge transfer reaction at thermal energies. It is concluded that at least 60% of the N^+ comes from short lived excited $(N_2^+)^*$. (auth)

24908 SCATTERING OF ALKALI IONS BY POLYCRYSTALLINE TARGETS. Pugacheva, T. S.; Shustrov, V. A. (Tashkent Polytechnic Inst.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 40-43(1975). (In Russian).

The results are presented of studies on the scattering of alkali metals as either ions or neutral atoms. Experimental data and computer calculations are compared. The energy dependence of the total scattering coefficients and the degree of ionization of the scattered particle flux is presented. (13 figures) (tr-auth)

24909 DOUBLE RAINBOWS IN ATOM MOLECULE SCATTERING. Buck, U.; Gestermann, F.; Pauly, H. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F. R. Germany)). Chem. Phys. Lett.; 33: No. 1, 186-190(15 May 1975).

High resolution measurements of the differential cross sections of Na atoms scattered from symmetrical top molecules exhibit a double rainbow structure which is attributed to the anisotropy of the potential. Calculations based on a semi-classical model in the sudden limit are in agreement with the measurements. (auth)

24910 CHEMILUMINESCENT ION-MOLECULE REACTIONS IN THE SYSTEM $C^+ + H_2$. Appell, J.; Brandt, D.; Ottinger, C. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F.R. Germany)). Chem. Phys. Lett.; 33: No. 1, 131-135(15 May 1975).

The optical emission resulting from collisions between C^+ ions and H_2 gas was measured in the energy range 2 to 20 $eV_{c.m.}$. The observed spectrum consists mainly of the CH^+ $A\,^1\Pi \rightarrow X\,^1\Sigma^+$ band system; CH^+ ($A\,^1\Pi$) is shown to be formed in the chemiluminescent reaction: $C^+(^2P^0) + H_2 \rightarrow CH^+(A\,^1\Pi) + H(^2S)$. The energy dependence of the emission cross section was measured. The occurrence of this reaction is discussed in terms of an electronic state correlation diagram for the system. (auth)

24911 FIRST BORN APPROXIMATION. Bell, K. L.; Kingston, A. E. (Queen's Univ., Belfast). Adv. At. Mol. Phys.; 10: 53-130 (1974).

An extensive review of Born approximation calculations is given for excitation by electron and proton impact, ionization by electron and proton impact, and excitation and ionization by atomic impact. The results are compared with available experimental data. (36 figures, 219 references) (GHT)

Atomic Theory

Refer also to abstracts 24825 and 24911.

24912 CONTRIBUTION OF THREE-BODY FORCES TO THE ATOM ENERGY. Gurchumeliya, A. D.; Safronova, U. I. (Georgian Polytechnic Inst., Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 78: No. 3, 585-588(Jun 1975). (In Russian).

The energy of the three-electron interaction u_{123} does not reduce to the sum of pair interactions $u_{12} + u_{13} + u_{23}$, and the difference $u_{123} - (u_{12} + u_{13} + u_{23})$ corresponds to the three-body potential, expressed by the sequence of Feynman's diagrams with three open ends. The calculation of the leading diagram of this sequence is performed, and its contribution to the energy of states $1s_{\frac{1}{2}}^2\,2s_{\frac{1}{2}}$ and $1s_{\frac{1}{2}}^2\,2p_{\frac{1}{2}}$ is evaluated. The results -0.122131 and -0.182900 a.u. are obtained, which are comparable with the contribution to the energy of the second-order diagram with two open ends (two-photon interchange), -0.286032 and -0.345670, respectively. (auth)

24913 HYDROGEN ATOM ON NULL-PLANE AND MELOSH TRANSFORMATION. Bell, J. S. (European Organization for Nuclear Research, Geneva (Switzerland)); Ruegg, H. (Geneva Univ. (Switzerland). Inst. de Physique Theorique). Nucl. Phys., B; 93: No. 1, 12-22(14 Jul 1975).

The null-plane dynamics of hydrogen-like atoms is studied in approximations depending on c, the velocity of light, being large. Neglecting terms in the Hamiltonian of order c^{-3} (relative to electron rest energy) a symmetry $SU(2)_W$ appears which is analogous to the $SU(6)_W$ of hadron classification. This symmetry, if accurate would dictate zero ground state magnetic moment. The symmetry is broken by terms of third order, which can, however, be transformed away by the appropriate approximation to the Melosh transformation. There then emerges a better symmetry, $SU(2)_M$, broken only at fourth order. The ground state magnetic moment acquires its usual non-relativistic value. The symmetry $SU(2)_M$ corresponds to a subgroup of a symmetry $[U(2) \times U(2)]_{FW}$ which appears in the old Foldy-Wouthuysen approach when spin-orbit coupling is neglected. As well as "current" and "constituent" pictures, "classification" pictures are distinguished; it is to one of the latter that the Melosh transformation transforms. (auth)

24914 MULLIKEN POPULATION ANALYSIS AND QUANTUM MECHANICAL PROBABILITY. Dobson, J. C.; Hinchliffe, A. (Chemistry Department, University of Manchester Institute of Science and Technology, Manchester M60 1QD, England). J. Mol. Struct.; 27: No. 1, 161-166(Jul 1975).

It is shown that, under certain conditions, the use of Mulliken gross atom populations for the analysis of molecular electronic wavefunctions is not without a basis in the rigorous probabilistic interpretation of quantum mechanics. (auth)

24915 LEVEL CROSSING MECHANISM IN NEW COHERENCE RESONANCE. Nakayaa, S.; Ogawa, T. Phys. Lett., A; 53: No. 2, 171-172(2 Jun 1975).

The mechanism of level crossing in the new coherence resonance for the case in which a spin-$\frac{1}{2}$ atom interacts with an oscillating rf field in optical pumping is theoretically analyzed considering the higher-order effects of a strong rf field. (auth)

24916 RELATIVISTIC SELF-CONSISTENT-FIELD CALCULATIONS WITH APPLICATION TO ATOMIC HYPERFINE INTERACTION. I. Relativistic Self-Consistent Fields. Lindgren, I.; Rosen, A. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Fysik). Case Stud. At. Phys.; 4: No. 3, 93-149(Mar 1974).

The theory of relativistic self-consistent Hartree-Fock equations are derived in general form. Results of numerical calculations are given. The standard procedure of averaging over configurations is described and extended to the multi-configurational case. General formulas are derived for the average one-electron energies and average total energy. The technique is applied to the averaging over an entire LS configuration in the relativistic case. Numerical examples are given. The statistical exchange approximations are reviewed, and their application to atomic calculations is discussed. The so-called Hartree-Slater model, which has recently been introduced by the present authors, is derived by means of an extended free-electron model. The various exchange approximations are compared for the Cu^+ ion. (auth)

24917 RELATIVISTIC SELF-CONSISTENT-FIELD CALCULATIONS WITH APPLICATION TO ATOMIC HYPERFINE INTERACTION. II. Relativistic Theory of Atomic Hyperfine Interaction. Lindgren, I.; Rosen, A. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Fysik). Case Stud. At. Phys.; 4: No. 3, 150-196(Mar 1974).

The theory of atomic hyperfine interaction is reviewed. The electro-magnetic field from the nucleus is expanded in multipole terms in a standard way. The hyperfine interaction is then treated as a perturbation and the perturbing Hamiltonian is expressed in general tensor-operator form in the nonrelativistic and relativistic cases. Explicit expressions are derived for the matrix elements in the single-electron scheme. The relativistic theory of Sandars and Beck for many-electron systems is reviewed. Regulations between the relativistic and non-relativistic hyperfine Hamiltonians are derived. Explicit expressions are given for the magnetic dipole, electric quadrupole, magnetic octupole and electric hexadecapole hyperfine Hamiltonians and for the corresponding hyperfine-structure constants. (auth)

24918 CORRESPONDENCE IDENTITIES AND THE COULOMB POTENTIAL. Norcliffe, A. (Sheffield Polytechnic (UK)). Case Stud. At. Phys.; 4: No. 1, 1-55(Nov 1973).

Three identities that exist between the classical and quantal theories of the Coulomb potential, when quantum numbers and corresponding action variables are small, are considered. These identities are the Rutherford, Bohr-Sommerfeld and Fock correspondence identities. The significance of these identities in the historical development of quantum mechanics and their roles in present day classical theories of atomic collision processes are reviewed. The three identities are explained and their relevance in semiclassical theories of wave mechanics is discussed. The links that exist between the Coulomb potential and other systems possessing correspondence identities are considered and the part played by dynamical symmetry in the existence of correspondence identities is discussed. New areas for research are pointed out. (auth)

24919 RELATIVISTIC EFFECTS IN THE MANY ELECTRON ATOM. Armstrong, L. Jr.; Feneuille, S. (CNRS, Orsay, France). Adv. At. Mol. Phys.; 10: 1-52(1974).

A review is given of the basic ideas as the starting point of relativistic calculations of atomic properties. Nonrelativistic limits are then discussed to exhibit the main differences between a relativistic and nonrelativistic treatment of atomic structure. The equivalent operator formalism is described and is applied to fine and hyperfine structures, the Zeeman effect, and transition probabilities. The problem of perturbation calculations in the relativistic scheme is briefly discussed and the calculation of relativistic radial wave functions is considered. (120 references) (GHT)

24920 PHOTOELECTRON SPECTROSCOPY. Price, W. C. (King's Coll., London). Adv. At. Mol. Phys.; 10: 131-171(1974).

A survey is given of the development of x-ray and ultraviolet photoelectron spectroscopy. Applications of photoelectron spectroscopy to studies of atomic electronic configurations are discussed, including: photoelectron spectra of hydrides isoelectronic with the inert gases; photoelectron spectra of the halogen derivatives of methane; photoelectron spectra of multiple bonded diatomic molecules; spectra and structure of some multiple bonded polyatomic molecules; spectra and structure of triatomic molecules; and methods of orbital assignment of bands in photoelectron spectra. Physical aspects are considered, including: intensities; selection rules; dependence of cross section on photoelectron energy; autoionization; angular distribution of photoelectrons; electron-molecule interactions; and transient species. (26 figures, 54 references) (GHT)

24921 DYE LASERS IN ATOMIC SPECTROSCOPY. Lange, W.; Luther, J.; Steudel, A. (Technische Univ., Hanover). Adv. At. Mol. Phys.; 10: 173-221(1974).

The properties of dye lasers which are relevant to atomic spectroscopy are discussed. Several experiments made possible by tunable dye lasers are discussed. Applications of high spectral density dye lasers are covered in areas such as: absorption spectroscopy, fluorescence spectroscopy, photoionization and photodetachment, and two- and multiphoton processes. Applications which take advantage of the narrow bandwidth of tunable dye lasers are discussed, including: saturation spectroscopy, fluorescence line narrowing, classic absorption and fluorescence spectroscopy, nonoptical detection of optical resonances, heterodyne spectroscopy, and nonlinear coherent resonant phenomena. (26 figures, 180 references) (GHT)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

24922 (BNL-20175) FLUCTUATIONS ABOVE THE SUPERFLUID TRANSITION IN LIQUID ^{3}He. Emery, V. J. (Brookhaven National Lab., Upton, N. Y. (USA)). Jun 1975. 9p. (CONF-750130-2) Dep. NTIS $4.00.

From international research workshop, and international symposium on quantum fluids; Sanibel, Florida, USA (26 Jan 1975).

It is shown that fluctuations above the superfluid transition in liquid ^{3}He depend strongly upon the relative angular momentum l of a Cooper pair but are insensitive to the fourth order term in the Ginsburg-Landau free energy. The effects are shown to be observable in the static magnetization, viscosity and spin diffusion and give a means of determining the value of l. (auth)

24923 UNIQUENESS THEOREM ASSOCIATED WITH SUPERFLUID ACOUSTICS. Murray, J. C. (Southampton Univ. (UK)). Phys. Lett., A; 53: No. 3, 191-192(16 Jun 1975).

Uniqueness theorems have been established previously for a range of linear initial-boundary value problems in theoretical physics which involve one governing field equation. The wave equation was included in these studies and the theorems obtained were applicable to the classical acoustic problem of gas dynamics. However, at low temperatures, quantum effects become important and the gas exhibits superfluidity properties. It then becomes necessary to employ two field equations to characterize the acoustic problem. A uniqueness theorem is obtained for the linear initial-boundary value problem of superfluid acoustics. (auth)

PHYSICS (HIGH-ENERGY)

24924 (NP-20514) WORK OF THE RUTHERFORD LABORATORY IN 1974. Smith, J. R.; Telling, F. M. (eds.). (Science Research Council, Chilton (UK). Rutherford Lab.). May 1975. 208p. Dep. NTIS (US Sales Only) $13.50.

Research programmes in particle physics, nuclear physics and radiobiology are based on the accelerator Nimrod, an 8-GeV proton synchrotron in the Laboratory. High-energy physics experiments are also carried out at international research centres, particularly at CERN in Geneva. Other fields of research at the Laboratory include theoretical physics, accelerator physics and branches of experimental physics which may have relevance to the long-term development of high-energy physics. Neutron Beam Research Unit was established to support the community of scientists who use neutrons generated in nuclear reactors as their principal research tool. The research and development programmes are supported by a computing system based on an IBM 370/195 computer which serves the requirements of the nuclear physicists and neutron beam users and also selected users in other fields. Research is reported under the headings high-energy physics, accelerator operations and development, instrumentation and data handling, applied research, neutron beam research, computing services, and technical services and administration. A few of the contributions contain significant data; with 13 pages of reference, however, one may assume that the research is reported more fully elsewhere. (104 figures) (RWR)

Particle Interactions and Properties (Experimental)

24925 (JINR-D1-2-8405) HIGH ENERGIES AND ELEMENTARY PARTICLES. Proceedings of the IV INTERNATIONAL SYMPOSIUM ON HIGH ENERGY AND ELEMENTARY PARTICLE PHYSICS, VARNA, BULGARIA, SEPTEMBER 22-27, 1974. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 376p. (In Russian and English). (CONF-7409121-).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

The conference contained 41 papers. Separate abstracts were perpared for seven papers. Other papers were title listed. (JFP)

For abstracts of individual papers see: 24926, 24929, 24937, 24945-24948, 24953-24957, 24968, 24969, 25011, 25013, 25014, 25026-25033, 25043-25045, 25055, 25063-25067, 25096, 25180, 25181, and 25187-25190.

24926 (JINR-D1-2-8405, pp 249-264) NEW POSSIBILITIES FOR CARRYING OUT RESEARCH ON THE HIGH-CURRENT PHASOTRON OF THE LABORATORY OF NUCLEAR PROBLEMS OF JINR. Roganov, V. S. (Joint Inst. of Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

24927 (UH-511-162-73) FIFTH HAWAII TOPICAL CONFERENCE IN PARTICLE PHYSICS, AUGUST 8-21, 1973. Participant seminars. Pilachowski, L. (ed.). (Hawaii Univ., Honolulu (USA)). Sep 1973. Contract AT (04-3)-511. 103p. (CONF-730856-S). Dep. NTIS $8.25.

Separate abstracts were prepared for the 19 papers presented. (JFP)

For abstracts of individual papers see: 24753, 24931, 24932, 24938-24941, 24949, 24972, 24985, 24999-25001, 25016-25018, 25090, 25099, and 25131.

24928 CHANNELING OF 1.1 GeV/c PROTONS AND PIONS. Fich, O.; Golovchenko, J. A.; Nielsen, K. O.; Uggerhoej, E. (Aarhus Univ. (Denmark)); Charpak, G.; Sauli, F. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 57: No. 1, 90-92(9 Jun 1975).

Channeling effects have been observed for 1.1 GeV/c protons and pions transmitted through a 1 mm thick germanium single crystal. (auth)

Electromagnetic

Refer also to abstract 25092.

24929 (JINR-D1-2-8405, pp 265-271) MEASUREMENT OF THE MAGNETIC MOMENT OF THE HYPERON. Kherinek, I. (Physics Inst., Prague). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

24930 (JINR-P1-8806) CALCULATION AND COMPARISON WITH EXPERIMENTAL DATA OF THE CASCADE CURVES FOR LIQUID XENON. Strugal'skii, Z. S.; Yablonskii, Z. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 19p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The cascade curves are listed which were calculated by the moment method for showers growing in liquid xenon. The calculated curves are compared with experimental data obtained from the analysis of shower pictures in a xenon bubble chamber. (auth)

24931 (UH-511-162-73, pp 1-4) SPEAR PROGRESS REPORT. Dakin, J. T. (Stanford Linear Accelerator Center, CA). Sep 1973.

From 5th topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

The status of the $e^+ - e^-$ storage ring SPEAR is reviewed. (auth)

24932 (UH-511-162-73, pp 87-89) MEASUREMENT OF INELASTIC COMPTON SCATTERING. Murphy, F. (Univ. of California, Santa Barbara). Sep 1973.

From fifth topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

The process gamma + p yields gamma' + X (inclusive gamma photoproduction) was measured to test the prediction that in the appropriate kinematic region, this process is dominated by single scattering from partons, is simply related to inelastic electron-proton scattering, and measures Q^4/Q^2 for the partons. The preliminary results make it seem likely that in this kinematic region inelastic Compton scattering is not dominated by the Bjorken-Pascos process. (JFP)

24933 PHOTOPRODUCTION OF π^+ MESONS ON POLARIZED PROTONS. Genzel, H.; Heide, P.; Knuetel, J.; Lierl, H.; Mess, K.-H.; Schachter, M. J.; Schmueser, P.; Sonne, B.; Vogel, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nucl. Phys., B; 92: No. 2, 196-206(23 Jun 1975).

The asymmetry of the cross sections for the photoproduction of π^+ mesons on polarized protons $\gamma + p \rightarrow \pi^+ + n$ has been studied in the four-momentum transfer range $0.1 \leq |t| \leq 1.25$ $(GeV/c)^2$ for photon energies of 2.5, 3.4 and 5.0 GeV. The measurements were carried out on a polarized butanol target. Both particles in the final state were detected: the pion by a magnetic spectrometer, the recoil nucleon in a scintillation counter matrix. The asymmetry was found to be negative with values around -0.4. (auth)

24934 ELECTROPRODUCTION OF ETA MESONS IN THE REGION OF THE RESONANCE $S_{11}(1535)$. Alder, J. C.; Brasse, F. W.; Fehrenbach, W.; Gayler, J.; Haidan, R.; Gloee, G.; Goel, S. P.; Korbel, V.; Krechlok, W.; May, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Nucl. Phys., B; 91: No. 3, 386-398(9 Jun 1975).

An experiment on electroproduction in the resonance region in the mass range $1505 \leq W \leq 1715$ MeV is reported. Data have been taken at $q^2 = 0.22$, 0.6 and 1 GeV^2. The angular distributions obtained support that η production proceeds mainly through S-wave excitation due to the resonance $S_{11}(1535)$. The total cross section of the formation of this resonance decreases much more slowly with increasing momentum transfer than the total ep cross section. (auth)

24935 CLASSICAL TREATMENT OF (g-2)-RESONANCE EXPERIMENTS. Ringhofer, K. (Univ., Munich). Acta Phys. Austriaca; 39: No. 2, 193-197(1974).

The Penning-gauge ion trap is one of the various experimental setups for the measurement of the anomalous magnetic moment of the electron. The discrete energy levels of the electron within the trap are obtained using an improvement of the Foldy-Wouthuysen transformation found previously. Although the new Foldy-Wouthuysen transformation simplifies quantum mechanical calculations, it is preferred to use a "classical" method, which allows one to calculate the energy levels of the trap without the slightest effort. The result is compared with quantum mechanical calculations. (auth)

Weak

24936 (ERDA-ORO-2504-235) HIGH ENERGY ACCELERATOR AND COLLIDING BEAM USER GROUP. Progress report, 1974-1975. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jul 1975. Contract AT (40-1)-2504. 42p. Dep. NTIS $5.25.

Experimental research in electromagnetic, strong, and weak interactions is summarized. A list of publications is included. (JFP)

24937 (JINR-D1-2-8405, pp 241-248) EXPERIMENTAL STUDY OF THE FORM FACTOR IN THE DECAYS $K_L^0 \to \pi + e + \nu$. Budapest-Dubna-Prague-Serpukhov-Sofia Collaboration. 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

24938 (UH-511-162-73, pp 4-7) NEUTRINO PROGRAM AT NAL. Nezrick, F. A. (National Accelerator Lab., Batavia, IL). Sep 1973.

From 5th topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

Neutrino research is summarized including the detection systems used and some of the published results. (JFP)

24939 (UH-511-162-73, pp 18-26) mu p INELASTIC SCATTERING EXPERIMENT No. 98 AT NAL. Anderson, H. L. (Univ. of Chicago). Sep 1973.

From 5th topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

Preparations are described for measuring the differential cross sections for mu p inelastic scattering over a wide range of q^2 and nu simultaneously. The incoming and outgoing energies and angles are measured directly and fairly precisely. Thus the scaling parameter is determined directly and unambiguously. (JFP)

24940 (UH-511-162-73, pp 40-43) SEARCH FOR THE WEAK INTERACTION CONTRIBUTION TO THE INTERACTION BETWEEN HADRONS. Hwang, C. (Los Alamos Scientific Lab., NM); McKibben, J.; Mischke, R. E.; Nagle, D.; Potter, J.; Frauenfelder, H.; Fritts, D.; Schultz, C.; Sorensen, L. Sep 1973.

From 5th topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

An experiment is described for measuring a parity violating effect in p + p scattering in order to determine the weak interaction contribution to the p + p interaction. The signal/noise ratio improvement and the sources of systematic error are discussed as well as the methods of detection. The experiment has not yet been performed. (JFP)

24941 (UH-511-162-73, pp 82-86) HADRONIC FINAL STATES FROM INELASTIC MUON SCATTERING IN A HYBRID BUBBLE CHAMBER EXPERIMENT. Carroll, J. T. (Stanford Linear Accelerator Center, CA). Sep 1973.

From fifth topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

The inelastic scattering of 16-GeV muons was studied in the reaction $mu^- + p$ yields $mu^- +$ hadrons. The total cross section for gamma/sub v/ + p yields p + rho^0 was found and a strong $omega^0$ signal was observed in this reaction. The average charged hadronic multiplicity and the integrated structure function are given for the muon reaction. (JFP)

24942 EVIDENCE FOR THE PRODUCTION OF A NEW PARTICLE IN NEUTRINO INTERACTIONS. Krishnaswamy, M. R.; Menon, M. G. K.; Narasimham, V. S. (Tata Inst. of Fundamental Research, Bombay (India)); Ito, N.; Kawakami, S.; Miyake, S. (Osaka City Univ. (Japan)). Phys. Lett., B; 57: No. 1, 105-108 (9 Jun 1975).

Evidence is presented based on 5 events recorded in cosmic ray experiments deep underground, for the production of new, massive ($\gtrsim$ 2 GeV) and long lived ($\tau \sim 10^{-9}$ sec) particles in neutrino interactions with rock nuclei. (auth)

Strong (Baryon-induced)

Refer also to abstract 25107.

24943 (BNL-20157) GAMMA SPECTRA FROM anti pp AND anti pd ANNIHILATIONS AT REST. Michael, D. N. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 17p. (CONF-750547-12). Dep. NTIS $4.00.

From 4th international symposium on nucleon-antinucleon interactions; Syracuse, New York, USA (2 May 1975).

A preliminary report is given on the results of an experiment which was an attempt to observe gamma rays of discrete energy from electromagnetic transitions from possible long-lived antiproton-nucleon bound states. The gamma and charged-particle spectra are shown. (JFP)

24944 (CONF-750654-7) DIFFRACTION DISSOCIATION OF NEUTRONS IN NP COLLISIONS AT FERMILAB ENERGIES. Biel, J.; Bleser, E. J.; Ferbel, T.; Freytag, D.; Gobbi, B.; Kenah, L.; Rosen, J.; Ruchti, R.; Slattery, P.; Underwood, D. (Rochester Univ., N. Y. (USA); Fermi National Accelerator Lab., Batavia, Ill. (USA); Stanford Linear Accelerator Center, Calif. (USA); Northwestern Univ., Evanston, Ill. (USA)). 1975. 15p. Dep. NTIS $4.00.

From international conference on high energy physics; Palermo, Italy (Jun 1975).

The reaction n + p yields (p pi^-) + p was investigated for neutron momenta in the range of 50 to 300 GeV/c. Substantial resonance production is observed, particularly in the kinematic regime where the Deck mechanism is not expected to be dominant. As expected for diffractive production, the cross section has very weak energy dependence. The characteristics of the angular correlations are qualitatively those predicted by the Deck model. (auth)

24945 (JINR-D1-2-8405, pp 130-134) SCALING OF INVARIANT CROSS SECTIONS FOR SEMI-INCLUSIVE REACTIONS: KNO. Akhababyan, N. O.; Grekova, L. D.; Penev, V. N.; Shklovskaya, A. I. (Inst. of Nuclear Research and Nuclear Power Engineering, Sofia). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

24946 (JINR-D1-2-8405, pp 135-139) SCALING TOPOLOGICAL CROSS SECTION WITH RESPECT TO LONGITUDINAL AND TRANSVERSE MOMENTA. Akhababyan, N. O. (Inst. of Nuclear Physics and Nuclear Power Engineering, Sofia); Grekova, L. D.; Markov, P. K.; Penev, V. N.; Shklovskaya, A. I.; Angelov, N.; Mel'nikova, N. N.; Solomin, A. N.; Shcheglova, L. M. 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

(Joint Inst. for Nuclear Research, Dubna (USSR)).

24947 (JINR-D1-2-8405, pp 210-214) DEUTERON-PROTON INTERACTIONS IN HYDROGEN BUBBLE CHAMBERS. Dubna-Warsaw Collaboration. 1974. (In Russian).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

24948 (JINR-D1-2-8405, pp 235-240) POSSIBLE EXPERIMENTS ON MONOCHROMATIC NEUTRON BEAMS. Gasparyan, A. P. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

24949 (UH-511-162-73, pp 60-65) SUMMARY OF DISCUSSION ON YUNNAN COSMIC RAY GROUP'S REPORT OF "EVIDENCE FOR THE POSSIBLE EXISTENCE OF A CHARGED PARTICLE WITH LARGE MASS". Maung, T. (Univ. of California, San Diego). Sep 1973.

From fifth topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

A discussion is summarized for a cosmic ray event appearing in a magnetized cloud chamber in which reportedly there is a high energy singly charged particle of mass greater than or equal to 10 GeV/c^2. The experimental conditions are listed. In this particle is a minimum ionizing particle with (beta gamma)/sub c/ equals 3.4 and momentum greater than or equal to 40 GeV/c, its mass is M/sub c/ equals P/sub c//(beta gamma)/sub c/ greater than or equal to 12 GeV/c^2. (JFP)

24950 ABSOLUTE CROSS-SECTION MEASUREMENTS USING NEUTRON BEAMS IN BUBBLE CHAMBERS. Ward, D. R. (Cambridge Univ. (UK). Cavendish Lab.). Nucl. Phys., B; 92: No. 1, 101-119(16 Jun 1975).

A novel technique is introduced for the investigation of neutron-proton interactions in a bubble chamber, based on the tagging of neutrons by their interactions, which has made possible the absolute normalization of the neutron beams in two experiments. In addition, measurements were made on elastic scattering and inclusive cross sections which have been largely inaccessible to existing bubble chamber techniques. (auth)

24951 FOUR-MOMENTUM TRANSFER DISTRIBUTION FOR THE DEUTERON BREAK UP AT 3.3 GeV/c INCIDENT DEUTERON MOMENTUM. Aladashvili, B. S.; Glagolev, V. V.; Lebedev, R. M.; Nioradze, M. S.; Saitov, I. S.; Streltsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR)); Badelek, B.; Odyniec, G.; Siemiarczuk, T. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej); Nassalski, J. Nucl. Phys., B; 92: No. 2, 189-195 (23 Jun 1975).

The differential cross section ($d\sigma/dt$) for the $dp \rightarrow ppn$ charge retention reaction at 3.3 GeV/c deuteron momentum is studied and compared with the Glauber multiple scattering theory. Within the limits of the uncertainties of the existing elementary nucleon-nucleon data, the simple Glauber model calculations give, in general, a fair agreement with experiment, except for the low $|t|$ region where possible spin effects may play a role. (auth)

24952 SOME FEATURES OF THE SPECTRA OF NUCLEONS FROM $pp \rightarrow NN + n_\pi\pi$ REACTIONS AT 19 GeV. Boeggild, H.; Dahl-Jensen, E.; Dahl-Jensen, I.; Hansen, K. H.; Hooper, J. E.; Lohse, E. R.; Mortensen, B.; Moeller, R. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., B; 91: No. 3, 365-385 (9 Jun 1975).

The momentum spectra of nucleons from pp collisions at 19 GeV are investigated for various fixed numbers of pions emitted together with them. Results on inelasticities, transverse and longitudinal spectra are presented, and the contribution of the various types of events to the forward (diffractive) proton peak is investigated. Evidence is found for a group of reactions where the two incoming protons stop each other. The average transverse momentum of the nucleons is found to increase with the number of pions emitted in the reaction (as long as this number is relatively small). (auth)

Strong (Meson-induced)

24953 (JINR-D1-2-8405, pp 116-122) INTERACTION OF HIGH ENERGY IONS WITH NUCLEONS. Alma-Ata-Budapest-Bucharest-Warsaw-Dubna-Krakow-Moscow-Sofia-Tashkent-Tbilisi Collaboration. (Joint Inst. for Nuclear Research, Dubna). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

24954 (JINR-D1-2-8405, pp 171-182) REGENERATION OF K_S^0 MESONS ON DEUTERIUM AT SMALL MOMENTUM TRANSFERS. Albrecht, K. F. (Institut fuer Hochenergiephysik, Berlin); Kaiser, H. J.; Meyer, A. 1974.

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

First results for the elastic regeneration of K_S^0 mesons on deuterium are presented for primary momentum from 10 to 40 GeV/c and at momentum transfers up to $|t| = 0.03(GeV/c)^2$. In the momentum range considered the slope of the differential cross section $d\sigma/dt$ is of the order of 25 $(GeV/c)^{-2}$ and within the errors independent of the momentum. The intercept for the ω trajectory is found to be 0.54 ± 0.04. (auth)

24955 (JINR-D1-2-8405, pp 215-223) INELASTIC π^+p INTERACTIONS AT ENERGIES OF 230 AND 275 MeV. Batusov, Yu. A. (Joint Inst. for Nuclear Research, Dubna); Bunyatov, S. A.; Gulkanyan, G. R.; Sidorov, V. M.; Musakhanov, M.; Ionitse, G.; Loznyanu, E.; Mikhul, V.; Tuvdendorzh, D. 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

24956 (JINR-D1-2-8405, pp 229-234) MEASUREMENT OF THE POLARIZATION PARAMETER P IN ELASTIC ($\pi^{+-}p$) SCATTERING AT 450 AND 485 MeV. Bekrenev, V. S.; Gaditskii, V. G.; Gordeev, V. A. (Leningrad Inst. of Nuclear Physics). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

24957 (JINR-D1-2-8405, pp 281-284) MASS DIFFERENCE OF K_L^0 AND K_S^0 MESONS. Volkov, M. K.; Pervushin, V. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

24958 BARYON RESONANCE COUPLINGS IN THE REACTIONS $\pi N \rightarrow \pi\Delta$ AND $\pi N \rightarrow \rho N$: COMPARISON WITH THEORY AND RELATED REACTIONS. Cashmore, R. J.; Leith, D. W. G. S. (Stanford Linear Accelerator Center, Calif. (USA)); Longacre, R. S.; Rosenfeld, A. H. (California Univ., Berkeley (USA). Dept. of Physics). Nucl. Phys., B; 92: No. 1, 37-50(16 Jun 1975).

Good agreement is found between the results of measurements of $\pi N \rightarrow \pi\Delta$ and the predictions of broken $SU(6)_W$ and Melosh transformations. The D13(~ 1700) is observed to be in a $[70, 1^-]$ while the P33 (~ 1700) is assigned to a $[56, 0^+]$. The signs of resonant amplitudes in $KN \rightarrow \pi\Sigma(1385)$, where reliably determined are in agreement with the results. There is surprisingly good agreement between the πN amplitudes and the corresponding photoproduction amplitudes. (auth)

24959 NEW DATA ON $K^-p \rightarrow \omega\Lambda$ AND A PARTIAL-WAVE ANALYSIS BETWEEN THE C. M. ENERGIES 1915 AND 2168 MeV. Nakkasyan, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 93: No. 1, 85-108(14 Jul 1975).

Cross sections of the reaction $K^-p \rightarrow \pi^+\pi^-\pi^0\Lambda$ are determined in a bubble chamber study at 10 incoming beam momenta between 1.425 GeV/c and 1.800 GeV/c. For the subsample $K^-p \rightarrow \omega\Lambda$, cross sections and angular distributions are presented together with their Legendre polynomial expansions and those of the single and joint density matrix elements. An energy dependent partial-wave analysis is performed including earlier data. The data are well fitted by constant background amplitudes in the outgoing S, P, and D waves plus two I = 0 resonances in this region, the well established $G_7\Lambda(2100)$ and the $P_3\Lambda(1870)$. (auth)

24960 SPIN-PARITY ANALYSIS OF THE 3π SYSTEM PRODUCED IN THE REACTION $\pi^+d \rightarrow \pi^-\pi^+\pi^+d$ AT 4 GeV/c. Emms, M. J.; Jones, G. T.; Kinson, J. B.; Stacey, B. J.; Votruba, M. F.; Woodworth, P. L. (Birmingham Univ. (UK)); Charlesworth, J. A.; Crennell, D. J.; Sekulin, R. L. (Science Research Council, Chilton (UK). Rutherford Lab.). Nucl. Phys., B; 93: No. 1, 1-6 (14 Jul 1975).

A spin-parity analysis of the low-mass 3π system produced in the reaction $\pi^+d \rightarrow \pi^-\pi^+\pi^+d$ has been performed using data from an exposure of the CERN 2m bubble chamber to a π^+ beam of 4 GeV/c momentum. Unnatural parity states predominate, 1^+ being much more significant than 0^- and 2^-. The $J^\pi = 2^+$ contribution in the A_2 region was found to be $(5 \pm 2)\%$. (auth)

24961 STUDY OF THE REACTIONS $\pi^+p \rightarrow K^+\Sigma^+$ AND $K^-p \rightarrow \pi^-\Sigma$ AT 10 GeV/c. Berglund, A.; Carlson, P. J. (Stockholm Univ. (Sweden)); Buran, T.; Endo, I.; Lundby, A. (European Organization for Nuclear Research, Geneva (Switzerland)); Damerell, C. J. S.; Gillman, A. R.; Hotchkiss, M. J.; Ratcliff, B. N.; Tso, T. Phys. Lett., B; 57: No. 1, 100-104(9 Jun 1975).

For the first time, the reactions $\pi^+p \rightarrow K^+\Sigma^+$ and $K^-p \rightarrow \pi^-\Sigma^+$ have been studied in the same apparatus. This has been done at an adequately high momentum (10.1 GeV/c) to allow a check of the prediction of exchange degeneracy, that the differential cross sections should be converging at high energy. The cross section has been measured for momentum transfers t between t_{min} and $t = -0.3\ (GeV/c)^2$. It is found that for both reactions the differential cross section shows an exponential fall, with no deviations right in to $t = t_{min}$ (where some other experiments have shown a dip in the cross section). Furthermore, the magnitude of the differential cross sections is found to be closely similar at t = 0, with a ratio $= 1.050 \pm 0.048$. However, the slope for the positive reaction is about 19% steeper than that for the negative reaction. (auth)

24962 THE $\Lambda\Lambda$ AND Ξ^-p MASS SPECTRA PRODUCED BY 2.2 GeV/c K^- INTERACTIONS ON NUCLEI. Wilquet, G. (Brussels Univ. (Belgium)); Knight, W. L. (European Organization for Nuclear Research, Geneva (Switzerland)); Guy, J. G.; Tovey, S. N. (SEE CODE-5677710 Science Research Council, Chilton (UK). Rutherford High Energy Lab.); Canter, J.; Mann, A.; Schneps, J.; Wolsky, G. (Tufts Univ., Medford, Mass. (USA)); Miller, D. J.; Stannard, F. R. (University Coll., London (UK)). Phys. Lett., B; 57: No. 1, 97-99(9 Jun 1975).

The S = −2 dibaryon states $\Lambda\Lambda$ and Ξ^-p have been studied with more than double previous statistics. Earlier indications of an enhancement at $M_{\Lambda\Lambda} = 2.37\ GeV/c^2$ are not confirmed. (auth)

24963 SPIN EFFECTS IN THE INCLUSIVE REACTIONS π^{+-} + p(pol) → π^{+-} + ANYTHING AT 8 GeV/c. Dick, L.; Gonidec,

A.; Gsponer, A.; Werlen, M. (European Organization for Nuclear Research, Geneva (Switzerland)); Caverzasio, C.; Kuroda, K.; Michalowicz, A.; Poulet, M. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire); Aschman, D.; Green, K. Phys. Lett., B; 57: No. 1, 93-96(9 Jun 1975).

The asymmetry in inclusive reactions of the type a + p(pol) → a + anything at 8 GeV/c (a = π^+, π^-, or p) have been measured at the CERN Proton Synchrotron using a polarized proton target. In the πp reactions and over a limited range of $p_T(0.17 \leq p_T \leq 0.36)$ GeV/c the results indicate i) an asymmetry for $x = p_T^*/p_{max}^* > 0.7$ which is mirror symmetric for the π^+ and π^- reactions; ii) an asymmetry compatible with zero for $0.3 < x < 0.7$. (auth)

24964 PHASE-SHIFT ANALYSIS OF $\pi^+\pi^-$ SCATTERING BETWEEN 1.1 AND 1.8 GeV BASED ON FIXED MOMENTUM TRANSFER ANALYTICITY. Froggatt, C. D. (Glasgow Univ. (UK). Dept. of Natural Philosophy); Petersen, J. L. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Nucl. Phys., B; 91: No. 3, 454-476(9 Jun 1975).

Using extrapolated $\pi^+\pi^-$ moments from amplitude analysis of the 17 GeV/c CERN Munich experiment on $\pi^-p \to \pi^+\pi^-n$ it is attempted to reduce phase-shift ambiguities by imposing fixed-t and fixed-u analyticity. The solution agrees qualitatively with semi-local duality. A phase-shift analysis is also performed by constraining the result to be compatible with the fixed-t (u) amplitudes. A smooth phase-shift solution is obtained showing a clear ρ' signal. (auth)

24965 DETERMINATION OF THE $K^+\pi^-$ TOTAL CROSS SECTION FOR C.M. ENERGY UP TO 1.8 GeV. Chliapnikov, P. V.; Gerdyukov, L. N.; Tchikilev, O. G.; Vorobjev, A. P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij); Grard, F.; Henri, V. P.; Herquet, Ph.; Windmolders, R. (Mons Univ. (Belgium)); Verbeure, F. (Institute for Higher Energies, ULB-VUB Brussels, Belgium); Ciapetti, G. Nucl. Phys., B; 91: No. 3, 413-424(9 Jun 1975).

The reaction $K^+p \to \Delta^{++}(1236)$ + anything is studied at beam momentum 8.2 GeV/c. The spin density matrix of the Δ^{++} shows that one-pion exchange is dominant at low-momentum transfer. The total and topological $K^+\pi^-$ cross sections have been determined by a Chew-Low extrapolation in the cm energy range from threshold to 1.8 GeV, using three different methods of extrapolation. (auth)

Particle Interactions and Properties (Theoretical)

24966 (ITP-75-48R) BEHAVIOR OF THE INCLUSIVE FORM FACTORS IN THE S-LIMIT. Maksimov, S. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The Jost-Lehmann-Dyson representation is used to obtain the sufficient conditions for factorization in S and ν of the leading term of the inclusive form factors in the large momentum transfer limit with fixed mass of the final hadronic states. (auth)

General

Refer also to abstracts 24925 and 24927.

24967 (CONF-750654-3) SPECTROSCOPY AFTER THE NEW PARTICLES. Lipkin, H. J. (Argonne National Lab., Ill. (USA)). Jun 1975. Contract W-31-109-Eng-38. 30p. Dep. NTIS $4.50.

From international conference on high energy physics; Palermo, Italy (Jun 1975).

Conventional spectroscopy was reexamined, and the puzzles and paradoxes which have arisen in attempting to describe the properties of the known particles are sought. It is noted that these may offer clues to the missing elements necessary for the description of the new particles. The minimum number of elementary building blocks, charm and color, the colored quark model for saturation, spin splittings in the meson spectrum, three kinds of quarks, the Melosh transformation and the Jackson frame, the Zweig rule mystery, new particles and old symmetries, f-A2 interference, and nonleptonic decay. (JFP)

24968 (JINR-D1-2-8405, pp 8-44) DYNAMICS OF PROCESSES WITH HIGH MOMENTUM TRANSFER. Matveev, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

24969 (JINR-D1-2-8405, pp 92-115) ALGEBRAIC APPROACH AND SUPERSELECTIVE STRUCTURE OF ELEMENTARY PARTICLES. Todorov, T. S. 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

24970 (JINR-P4-8836) INTERACTION OF SLOW π^--MESONS WITH NUCLEI. Arsen'ev, D. A.; Bunatyan, G. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 27p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The detailed consideration of the structure of the effective quasipotential describing the interaction of π-mesons with nuclei based on the multiple scattering theory which makes use of the experimental πN-scattering results is given. Experimentally observed energies and widths of various π-mesic atoms are calculated with the help of this potential. Rather good description of the known experimental results is obtained. The dependence of the results on the parameters of this potential has been studied in detail. (2 figures, 3 tables) (auth)

24971 (ORO-3992-231) CHARGE TRANSFER DISTRIBUTIONS BASED ON THE INDEPENDENT EMISSION OF NEUTRAL AND CHARGED CLUSTERS. Chiu, C. B.; Pokorski, S.; Wang, K. H. (Texas Univ., Austin (USA). Center for Particle Theory). 1975. Contract AT(40-1)-3992. 26p. Dep. NTIS $4.50.

Within independent cluster emission models, one studies the constraint imposed by charge transfer data on M, the mean number of charged particles per cluster. For definiteness, one considers a simple B-cluster model, which admits the emission of both the neutral and the charged clusters. By varying the relative emission strength, M is allowed to vary from two to three. It is found that for either neutral or charged clusters, one may have the predicted charge transfer dispersion proportional to the single particle inclusion cross section. Furthermore, the available charge transfer distributions at alpha equals 0 can also be fitted for various values of M. However, as M is lowered from 3 to 2, it is necessary for the gaussian width of the decay pion rapidity distribution to vary from 1 to 1.6. The results combined with another independent analysis show that, the B-cluster model with M equals 3 constitutes a simple model, which reproduces many features of charge transfer, two-particle correlation and gap distribution data. (auth)

24972 (UH-511-162-73, pp 96-99) SPECULATIONS ON THE BREAKDOWN OF SCALING. Chanowitz, M. (Stanford Linear Accelerator Center, CA). Sep 1973.

From fifth topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

A poor man's parton model is described in which the partons are just another layer of matter, with structure like the layers which have come before. One is guided not by meager intuition about strongly interacting field theories but rather by analogies based on better understood areas of physics, especially nuclear physics. Electroproduction from a nucleus is considered, and scaling is discussed. (JFP)

24973 DYNAMICAL MODEL OF SPIN-1 AND SPIN-0 PARTICLES. Tevikian, R. V. (AN Armyanskoj SSR, Erevan. Inst. Fiziki). Nucl. Phys., B; 93: No. 1, 74-84(14 Jul 1975).

Equations are proposed that completely describe $s = 0, \frac{1}{2}, 1$ particles, i.e., specify $2s + 2$ limiting states in the $E \to \infty$ limit. A set of states closed with respect to the $E \to \infty$ limiting procedure is considered, whence follows the necessity for the introduction of a λ-state corresponding to one-dimensional unitarity representation of the Lorentz group. It is shown further, that a cosmological term proportional to the square of the λ-state strength should be introduced in gravitation theory. On the basis of the Lorentz group, a table of fundamental interactions is proposed, and a dual transformation for the interacting system is introduced. (auth)

24974 SUPERSYMMETRIC GLUON MODEL. Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 93: No. 1, 23-28(14 Jul 1975).

It is pointed out that parity doubling does not provide a satisfactory resolution of the conflict between parity and fermion-number conservation in supersymmetric gauge theories. A new generalized gauge principle is proposed which overcomes this difficulty for both Abelian and non-Abelian local symmetries. (auth)

24975 DIFFRACTIVE CHANNELS IN ABSORPTIVE EIKONAL MODELS. Camillo, P. J.; Fishbane, P. M.; Schaffner, J. G.; Trefil, J. S. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Phys. Lett., B; 57: No. 1, 63-65(9 Jun 1975).

The effects of intermediate diffractive states on elastic scattering and diffractive production are investigated in the framework of an eikonal model. Multiparticle production in the guise of the eikonal function restricts the diffractive coupling. Bounds on the ratios σ_{el}/σ_T and σ_{diff}/σ_T are discussed. (auth)

24976 NEW SUPERSYMMETRIC STRING MODEL AND THE SUPERGAUGE CONSTRAINTS IN THE DUAL RESONANCE MODELS. Chang, L. N. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics); Macrae, K.; Mansouri, F. (Yale Univ., New Haven, Conn. (USA). Dept. of Physics). Phys. Lett., B; 57: No. 1, 59-62(9 Jun 1975).

A new supersymmetric string model is presented which can carry spin and other quantum numbers and in which the supergauge constraints arise naturally. The known dual models involving fermions are obtained as special cases. (auth)

24977 HYDRODYNAMICAL MODEL OF MULTIPARTICLE PRODUCTION. Peressutti, G. (Goeteborg Univ. (Sweden). Institutionen foer Teoretisk Fysik). Nucl. Phys., B; 92: No. 1, 58-60(16 Jun 1975).

By reconsidering a solution of Landau's model with viscosity taken into account, obtained in the frame of the one-dimensional approximation of Emel'yanov, the consequences of the equation of state $p = c_s^2 \epsilon$ are studied. (auth)

24978 EFFECT OF BOSE-EINSTEIN STATISTICS ON TWO-PARTICLE AZIMUTHAL AND RAPIDITY CORRELATIONS. Ranft, J.; Ranft, G. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). Nucl. Phys., B; 92: No. 2, 207-220(23 Jun 1975).

The short-range effect in azimuthal and rapidity correlations can be explained within the independent cluster model taking into account the cluster transverse momentum and the Bose-effect (identical particle effect) in the single as well as the two-cluster term. Good agreement with data from Dubna, NAL and ISR is obtained. From the data parameters related to the longitudinal and transverse dimensions of the clusters are determined. (auth)

24979 ZITTERBEWEGUNG OF PARTICLES WITH ARBITRARY SPIN. Izmailov, S. V.; Levin, E. S. (Leningrad State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 52-60(1975). (In Russian).

The existence of zitterbewegung in particles with higher spins ($s \geq 1$) was shown. The concepts of Currie, Iordan, and Sudarschan on the two aspects of relativistic invariance and the determination of the dynamic variables describing a system with arbitrary spins obtained by Iordon and Mukunda were used as the basis of the study. A series of new paradoxical properties of zitterbewegung, unknown in the Dirac theory, was found. For example, particles with higher spins ($s \geq 1$) can have a velocity greater than the speed of light. In the general form it was shown that the elimination of zitterbewegung in all directions of space and even in a plane is impossible. Only partial elimination of zitterbewegung in one of the spatial directions and then only at the cost of breakdown of the relativistic invariance of the theory is possible. The assumption is made that the paradoxical properties of zitterbewegung can be understood if the momentum and mass operators are redetermined. In this manner the relation of zitterbewegung with tachyons is discussed. (tr-auth)

24980 POSSIBLE DESCRIPTION OF EXTENDED PARTICLES IN THE NON-LINEAR FIELD THEORY. Nisichenko, V. P.; Rybakov, Yu. P. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 61-64 (1975). (In Russian).

A generalization is proposed of the method of strong forces which is used for the description of extended particles in the framework of the scalar theory of fields with the interaction expressed in terms of powers of the complex. For the interaction $\lambda\varphi^4$ the energy spectrum of the lower one-particle excitation was determined by the variational method. (tr-auth)

24981 MULTIPERIPHERAL CLUSTER THEORY AND ITS COMPARISON WITH EXPERIMENT. Dremin, I. M.; Dunaevskii, A. M. (AN SSSR, Moscow. Fizicheskij Inst.). Phys. Rep.; 18: No. 3, 159-216(May 1975).

Multiperipheral schemes are briefly reviewed. Different models (and, especially, the multicluster production model) are treated within the multiperipheral approach. General qualitative and semiquantitative results as well as their possible modifications are discussed and compared with experiment. Quantitative applications of the theory to many particle production experiments are considered. (auth)

24982 RELATIVISTIC GRAND ANGULAR MOMENTUM IN THREE-BODY DECAYS. Dziembowski, Z. (Warsaw Univ. (Poland). Instytut Fizyki Teoretycznej). Nucl. Phys., B; 91: No. 3, 399-412(9 Jun 1975).

The grand angular momentum (GAM) basis is constructed for the system of free, spinless, relativistic particles. An explicit form of the basis vectors (for the case of three particles) is used for the description of the three-pion decays. The use of the GAM basis opens new possibilities for the applications of Dalitz diagrams in studies of sizes of resonances. Isosinglet Dalitz diagrams are shown for a few values of angular momentum and parity, and corresponding to definite values of angular momentum and parity, and corresponding to definite values of the parameter Γ. (auth)

24983 SHORT- AND LONG-RANGE AZIMUTHAL CORRELATIONS IN A NEUTRAL CLUSTER MODEL. Bopp, F. W. (Gesamthochschule Siegen, Abteilung fuer Physik, 5930 Huettental-Weidenau, Hoelderlinstr. 3, Federal Republic of Germany). Nucl. Phys., B; 91: No. 3, 445-453(9 Jun 1975).

Azimuthal correlations are investigated in a neutral cluster model in which the clusters are formed with small but nonvanishing transverse momenta and in which the kinematical correlations by transverse momentum conservation are considered in a statistical approximation. Relations for the positive and negative short-range component and for the smooth long-range component are obtained and found in agreement with existing data. The azimuthal correlations enable an estimate of the average transverse momentum of the clusters to be made, which is a quantity of fundamental interest. (auth)

Electromagnetic

Refer also to abstracts 25208 and 25231.

24984 (JINR-E2-8894) CONVERGENT ELECTROMAGNETIC NUCLEON MASS DIFFERENCE, CORNWALL-NORTON MOMENTS AND LIGHT CONE EXPANSIONS. Motz, G.; Wieczorek, E. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 35p. Dep. NTIS (US Sales Only) $4.75.

Conditions for convergence of the electromagnetic nucleon mass difference are formulated in terms of Cornwall-Norton moments. Various aspects of light-cone expansions are discussed. It is proved that the momenta are uniquely related to the coefficient distributions of the Taylor series for the commutator. (auth)

24985 (UH-511-162-73, pp 13-17) HIGH ENERGY PHOTON EXPERIMENTS AT NAL. Wattenberg, A. (Univ. of Illinois, Urbana). Sep 1973.

From 5th topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

The proposed high energy photon experiments are total cross sections, Compton elastic and inelastic scattering, rho and phi photoproduction on hydrogen and complex nuclei, diffraction production of J/sup P/ equals 1^- mesons not previously observed, and linearly polarized photons. The tagged and high intensity beams, and the monitors and detectors are discussed. (JFP)

24986 ASYMPTOTIC CONSTRAINTS ON SIGMA SUP(TOTAL) SUB(e^+e^-) IN ASYMPTOTICALLY FREE THEORIES. Cornille, H.; Martin, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 93: No. 1, 61-73(14 Jul 1975).

Using the analyticity properties of the vacuum polarization function conditions are obtained on the e^-e^+ total cross section from the behavior of this function for spacelike directions, where it is known in asymptotically free field theories. This work constitutes a generalization of the results of Healy. (auth)

24987 PION ASYMMETRY IN THE THREE-BODY RADIATIVE DECAYS OF POLARIZED HYPERONS. Ebrahim, A.; Oenenguet, G. (Middle East Technical Univ., Ankara (Turkey)). Nucl. Phys., B; 93: No. 1, 176-188(14 Jul 1975).

The energy dependence of pion asymmetry was calculated relative to the direction of hyperon polarization in the three-body radiative decays of polarized hyperons, using the inner bremsstrahlung model. It is found that in the low pion energy region, the pion asymmetry in the radiative decay relative to the nonradiative decay is kinematically enhanced. For certain decays, this effect could be exploited experimentally to obtain additional information about the properties of the hyperons. (auth)

24988 COHERENT SCATTERING OF PHOTON BEAMS AND NON-LINEAR QED. Yueh, W. R. (Florida Univ., Gainesville (USA). Dept. of Physics and Astronomy). Nucl. Phys., B; 93: No. 1, 153-164(14 Jul 1975).

The scattering initiated by high intensity, coherent beams is

reformulated. The case with GeV gamma rays and coherent beam scattering is also discussed. The possible enhancement of this process by considering Dirac-Kapitza mechanism, induced scattering and external field case is presented. The physical impact on the verification of this process is discussed at the end. (auth)

24989 ELECTROMAGNETIC FORM FACTORS OF N* RESONANCES AND THEIR DETERMINATION FROM PION ELECTROPRODUCTION. Devenish, R. C. E. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Lyth, D. H. (Lancaster Univ. (UK)). Nucl. Phys., B; 93: No. 1, 109-137(14 Jul 1975).

It is shown how N* electromagnetic form factors can be parameterized in a simple way to take account of their known behavior at threshold. Using such form factors and Breit-Wigners to represent the final-state interaction the imaginary parts of the invariant amplitudes for the process $eN \to eN\pi$ are calculated, the real parts are calculated from fixed t dispersion relations. The complete amplitudes are then fit to the coincidence data in the resonance region ($0 < |\lambda^2| < 1.0$ GeV^2; $w < 2$ GeV) in order to determine the form factor parameters. Results are presented for the λ^2 dependence of the resonant multipoles and in particular stable results for the P_{11} (1434), S_{11} (1505), D_{13} (1520), F_{15} (1688) and F_{37} (1940) are found. A critical discussion is given of the effect of theoretical uncertainties on the results. The results are used to calculate the helicity asymmetry A on the resonant peaks seen in eN scattering and it is found that on the 2nd and 3rd peaks A changes sign in the vicinity of $\lambda^2 = -1$ GeV^2. (auth)

24990 ELECTRON-POSITRON ANNIHILATION: STATISTICAL AND THERMODYNAMIC CONSIDERATIONS. Grammar, G. Jr.; Nieh, H. T.; Yao, Y. P. (State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics). Phys. Lett., B; 57: No. 1, 66-68(9 Jun 1975).

Light cone considerations suggest that, in e^+e^- annihilation, the hadronic matter is initially created within a spatial volume in the c.m. frame of the order of E^{-3}, where E/2 is the colliding beam energy. Its implications, within the statistical thermodynamic descriptions of Fermi and Landau, are conjectured. A distinctive result is that the multiplicity for e^+-e^- annihilation is a constant. (auth)

24991 CREATION AND ANNIHILATION OF ELECTRON-POSITRON PAIRS IN SUPERSTRONG MAGNETIC FIELD. Sokolov, A. A.; Ternov, I. M.; Borisov, V. V.; Zhukovskii, V. Ch. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 65-71 (1975). (In Russian).

The creation and annihilation of electron-positron pairs in a superstrong magnetic field $H \geq H_0 = m_0^2c^3/\hbar e_0 = 4.41 \times 10^{13}$ G was examined. It was shown that states close to the ground states give a substantial probability to the probability of the processes. (tr-auth)

24992 PAIR CREATION IN FINITE-TIME ELECTRIC FIELD. Gitman, D. M.; Shakhmatov, V. M.; Shvartsman, Sh. M. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 23-29 (1975). (In Russian).

An expression was obtained for the probability of pair creation in a homogeneous electric field with finite time of effect and in a constant inhomogeneous field parallel to one side. The dependence of the probability during small and large time effect of the electric field was studied. (tr-auth)

24993 NEW PRECISE SOLUTION OF THE DIRAC EQUATION. II. Bagrov, V. G.; Gitman, D. M.; Zadorozhnyi, V. N.; Lavrov, P. M.; Shapovalov, V. N. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 29-33(1975). (In Russian).

New precise solutions of the Dirac and Klein-Gordon equations for charge in orthogonal, equal with respect to size, inhomogeneous fields of special shape were found. The six different types of fields permitting a precise solution were examined. (tr-auth)

24994 BREMSSTRAHLUNG RADIATION AND PAIR FORMATION AT VERY HIGH ENERGIES IN A CONDENSED, AMORPHOUS MATERIAL. Ryazanov, M. I. (Moscow Engineering-Physics Inst.). Usp. Fiz. Nauk; 114: No. 3, 393-414(Nov 1974). (In Russian).

The present, theoretical state of bremsstrahlung radiation from very high energy electrons and pair formation by very high energy gamma quanta in a condensed substance in the case where the effective length of the coherence of these processes is so great that there is a possible effect from competing processes is reviewed. Qualitative ideas are considered by means of which it is possible to estimate the effects correctly, and the results of a quantitative look are presented. (SJR)

24995 ELECTRIC CHARGE OF ELEMENTARY PARTICLES. Akhiezer, A. I.; Rekalo, M. P. (Physical-Technical Inst., Kharkov). Usp. Fiz. Nauk; 114: No. 3, 487-508(Nov 1974). (In Russian).

The review deals with a systematic presentation of the basic, physical ideas lying at the base of experiments on verifying the law of conservation of electric charge in interactions of elementary particles and also in experiments demonstrating quantization of the electric charges of all known elementary particles. Experiments are considered in which it is demonstrated with great accuracy that there is an equality in the absolute value of the electric charges of the proton, electron, muon, neutral atoms, neutron, electron and muon neutrino and the gamma quantum. A presentation is given of the results of measuring the magnetic moments of the electron and proton, and a procedure is given for finding from these data the absolute value of the electric charge of a proton which is one of the fundamental physical constant known today with an accuracy on the order of a few million parts. The possible connection between quantization of electric charge and the existence of magnetic monopoles is discussed. In addition, the review presents the results of experiments on a search of the electric dipole moment of elementary particles, namely, the neutron, proton, electron, muon, Λ-hyperon and neutrino. The literature is reviewed up to the end of 1973. 58 refs. (SJR)

24996 ELECTRON IN THE QUANTIZED FIELD OF A PLANE WAVE AND IN THE CLASSICAL FIELD OF A LONGITUDINAL, ELECTRIC WAVE. Bagrov, V. G.; Gitman, D. M.; Shvartsman, Sh. M. (Tomsk State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 3, 67-71(1975). (In Russian).

A solution of the Dirac equation is obtained for an electron moving in the quantized field of a plane wave and in a classical field of a traveling, longitudinal electric wave which is being propagated in one direction. By means of a canonical transformation of the photon generation and annihilation operators the problem is reduced to a quasiparticle one, in which the energy of the quasiparticles depends on the time and the coordinates. (tr-SJR)

24997 TAKING INTO ACCOUNT POLARIZATION EFFECTS IN THE METHOD OF SURFACE ENVELOPES IN THE CLASSICAL THEORY OF SYNCHRONOUS RADIATION. Kukanov, A. B.; Naumov, N. D. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 151-152(1975). (In Russian).

The equation of motion of a charge along a spiral line is given. The electric and magnetic fields created by the moving charge are then presented. The radiation polarization is taken into account by breaking down the Fourier-figure of the electric field according to a set of three vectors. Further precise calculations are carried out. It is evident from the final formula determining the spectral distribution of the radiation intensity that the synchronous radiation is completely elliptically polarized. (SJR)

24998 QUANTIZATION AND RENORMALIZATION OF THEORIES WITH GAUGE-SYMMETRIES AND WITH SPONTANEOUS SYMMETRY-BREAKING. Kummer, W. (Technische Hochschule, Vienna). pp 39-99 of Some Topics in Weak Interactions. Zaragoza, Spain; Universidad de Zaragoza (1974).

From proceedings of the V gift seminar in theoretical physics; Zaragoza, Spain (3 Jun 1974). See CONF-7406106-.

The purpose of this lecture is to provide the necessary technical background in order to perform actual calculations in any unified theory of weak and electromagnetic interactions. The main difficulties inherent in the canonical quantization and in theories with gauge invariance, the path integral formalism, renormalization in a symmetric gauge theory and in the spontaneously broken sigma model, renormalization in a spontaneously broken gauge theory, and an outline of the general proof of renormalization are discussed. (JFP)

Weak

Refer also to abstracts 24889 and 25187.

24999 (UH-511-162-73, pp 8-12) CPT NON-INVARIANCE AND WEAK INTERACTIONS. Hsu, J. P. (Univ. of Texas, Austin). Sep 1973.

From 5th topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

In this talk, I will describe a possible violation of CPT invariance in the domain of weak interactions. One can construct a model of weak interactions which, in order to be consistent with all experimental data, must violate CPT maximally. The

model predicts many specific results for decay processes which could be tested in the planned neutral hyperon beam or neutrino beam at NAL. The motivations and the physical idea in the model are explained, and the implications of the model are discussed. (auth)

25000 (UH-511-162-73, pp 53-55) RENORMALIZATION OF GAUGE THEORIES OF WEAK INTERACTIONS. Lee, B. W. (State Univ. of New York, Stony Brook). Sep 1973.

From fifth topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

The renormalizability of spontaneously broken gauge theories is discussed. A brief outline of the motivation for such an investigation is given, and the manner in which the renormalizability of such theories is proven is described. The renormalizability question of the unbroken gauge theory is considered, and the formulation of a renormalizable perturbation theory of Higgs phenomena (spontaneously broken gauge theories) is considered. (JFP)

25001 (UH-511-162-73, pp 66-78) COLOR THE QUARK "MUON". Kalbfleisch, G. R. (Brookhaven National Lab., Upton, NY); Fowler, E. C. Sep 1973.

From fifth topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

It is proposed that leptons are quarks. Unstable baryonic quarks must also exist. A specific scheme based on the Han–Nambu model is presented. Conservation of the quantum numbers is obtained in all processes except the purely nonleptonic ones. (auth)

25002 WEAK U-SPIN AND THE WEAK INTERACTION. Feldman, G.; Matthews, P. T. (Imperial Coll. of Science and Technology, London (UK). Dept. of Physics). Phys. Lett., B; 57: No. 1, 69-72(9 Jun 1975).

The GIM mechanism for excluding certain unwanted consequences of neutral weak currents is cast in a simple group theoretic form. The required selection rules are shown to follow from the invariance of the weak interaction with respect to a weak U-spin. (auth)

25003 PARTON–NUCLEON RECIPROCITY AND THE FRAGMENTATION OF WEAK CURRENTS. Horgan, R. R.; Scharbach, P. N. (Oxford Univ. (UK). Dept. of Theoretical Physics). Phys. Lett., B; 57: No. 1, 54-58(9 Jun 1975).

Some consequences of the parton-nucleon reciprocity relation for the production of nucleons by fragmentation of weak currents, both neutral and charged, are discussed. (auth)

25004 K_{l3} DECAY AND QUARK MODEL COMMUTATORS. Schilcher, K. (Oxford Univ.). Acta Phys. Austriaca; 39: No. 1, 83-88(1974).

Mass dispersion relations for the scalar form factor in K_{l3} decay are used to relate the soft pion point to a physical point. A modified amplitude that depends only weakly on the κ-meson parameters is chosen to perform this extrapolation. The κ-K-π coupling constant is eliminated; instead the asymptotic behavior of the amplitude must be known exactly. This asymptotic form is determined in the quark model. As a by-product, numerical values for the parameters ϵ_8 and ϵ_9 which are related to quark masses are obtained. The (3,3*) + (3*,3) model together with a value of c close to $-\sqrt{2}$ leads to a large negative value of the decay parameter. (auth)

25005 BROKEN SU(3), ASYMPTOTIC SYMMETRY AND NONLEPTONIC HYPERON DECAYS. Morales, A. (Univ., Zaragoza, Spain); Sanchez, J. G. Acta Phys. Austriaca; 39: No. 2, 97-113(1974).

The nonleptonic hyperon decay amplitudes are evaluated by means of an explicit medium strong hamiltonian in the asymptotic symmetry approximation. No use of the Wigner-Eckart theorem is made. (auth)

25006 SOME TOPICS IN WEAK INTERACTIONS. Proceedings of the V GIFT Seminar in Theoretical Physics, Zaragoza, Spain, June 3–7, 1974. Zaragoza, Spain; Universidad de Zaragoza (1974). 262p. (CONF-7406106-).

Separate abstracts were prepared for the five papers presented. (JFP)

For abstracts of individual papers see: 24998, 25007, 25008, 25059, and 25060.

25007 WEAK CURRENTS AND GAGE MODELS. Pietschmann, H. (Univ., Vienna). pp 1-38 of Some Topics in Weak Interactions. Zaragoza, Spain; Universidad de Zaragoza (1974).

From proceedings of the V gift seminar in theoretical physics; Zaragoza, Spain (3 Jun 1974). See CONF-7406106-.

The discussion of weak currents and gauge models includes the classical weak currents, coupling of the currents, tests of the structure of weak currents, neutral currents, and gauge models. (JFP)

25008 WEAK INTERACTIONS OUTSIDE THE PHYSICAL LABORATORIES. Marx, G. (Eotvos Univ., Budapest). pp 197-227 of Some Topics in Weak Interactions. Zaragoza, Spain; Universidad de Zaragoza (1974).

From proceedings of the V gift seminar in theoretical physics; Zaragoza, Spain (3 Jun 1974). See CONF-7406106-.

The discussion of weak interactions outside the physical laboratories covers neutrino glowing of astonomical objects, neutral current effects in atomic and molecular phenomena, and Higgs-type symmetry breaking and the cosmological history of the universe. (JFP)

Strong (General)

Refer also to abstract 25070.

25009 (CONF-750654-10) WHAT ARE TOTAL CROSS SECTION DATA TRYING TO TELL US. Lipkin, H. J. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 11p. Dep. NTIS $4.00.

From international conference on high energy physics; Palerno, Italy (Jun 1975).

Striking regularities in the data for hadron–proton cross sections are discussed including the Regge contribution, pomeron structure, and the additive quark model. (JFP)

25010 (COO-2009-110) THEORETICAL PARTICLE PHYSICS. Progress Report, 1 December 1974–30 November 1975. Chu, S. Y.; Hendry, A. W.; Lichtenberg, D. B. (Indiana Univ., Bloomington (USA). Dept. of Physics). 1975. Contract AT(11-1)-2009. 21p. Dep. NTIS $4.25.

The research can be divided into two categories, the first dealing with the phenomenological treatment of two-body collisions, and the second dealing with symmetry-breaking and more speculative topics such as charm. In the first category, spin-correlations in proton-proton elastic scattering, made a model of inclusive interactions using triple-pomeron exchange, calculated the cross section and polarization in the reaction pp yields pi^+d using Regge exchange, estimated masses and widths of resonances by extrapolating scattering amplitudes to their poles in the complex energy plane, and are now undertaking a phase-shift analysis of pion-nucleon scattering at intermediate energies. In the second category, mass relations were obtained for charmed hadrons using broken SU(4) and SU(8) within the framework of the quark and quark-diquark models, have undertaken a program of calculating meson masses in the quark model using attractive 1/r plus linear confining potentials, and have calculated pi^+-pi^0 mass difference in the quark model. (auth)

25011 (JINR–D1-2-8405, pp 353-359) STATISTICAL CHAIN DECAY OF FIREBALLS WITH QUANTUM NUMBERS. Katona, Z. (Etvesha Univ., Budapest). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25012 ELASTIC SCATTERING AND TRANSVERSE MOMENTUM CORRELATION IN MULTIPERIPHERAL MODELS. Kubar-Andre, J.; Le Bellac, M.; Meunier, J. L. (Nice Univ., 06 (France). Lab. de Physique Theorique). Nucl. Phys., B; 93: No. 1, 138-152(14 Jul 1975).

The overlap function and transverse correlations are computed in various versions of the multiperipheral model. In particular the closeness of the bound is examined for the pomeron slope recently derived by Krzywicki. Correlations between neighboring transverse momentum transfers in the S-matrix element are shown to be able to bring the multiperipheral model in agreement with experiment. The case of cluster production is also studied, and a possible improvement of Krzywicki's bound is suggested. (auth)

Strong (Baryon No. = 0)

25013 (JINR–D1-2-8405, pp 45-73) LOW-ENERGY PHYSICS OF PIONS. Volkov, M. K.; Pervushin, V. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25014 (JINR–D1-2-8405, pp 360-369) NUMERICAL STUDIES OF THE STATISTICAL BOOTSTRAP MODEL AND APPLICATION TO N $\bar{N}$ ANNIHILATION AT REST. Ilgenfritz, E. M. (Karl-Marx-Univ., Leipzig). 1974.

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

For the generalization to different kinds of particles and fireballs carrying the given quantum numbers it is not obvious whether one has to include subfireballs with exotic quantum numbers in the sum over intermediate states of the decay cascade or not. Therefore, models were studied both with exotic states allowed and excluded to look for different results comparable with data. The predictions of various statistical bootstrap models for pionic $\bar{p}p$ and $\bar{p}n$ annihilation at rest are found and compared with data. (JFP)

25015 (JINR–P2-8812) SOLUTION OF A SINGULAR QUASIPOTENTIAL EQUATION FOR BOUND STATES. Gogokhiya, V. Sh.; Mavlo, D. P.; Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 31p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

The Logunov–Tavkhelidze equation for scalar particles of equal masses and for a quasipotential having in the coordinate representation the form $V(r) = gr^{-1}$ was reduced to the differential boundary value problem of the second order in the momentum representation. The corresponding problem for bound states is considered in detail for S waves. By the solution-matching method there was obtained the spectrum of weakly bound states, which turned out to be similar to the energy spectrum of the Schröedinger equation with the potential $V(r) = -g'r^{-2}$. But, in contrast to the latter case, in this solution there appears no collapse onto the scattering center. The comparison equation method (CEM) is formulated and applied to the mentioned problem. By the use of this method the discrete energy spectrum for arbitrary binding energies was obtained. (1 figure) (auth)

25016 (UH-511-162-73, pp 32-34) SIMPLE UNITARITY–DUALITY APPROACH TO THE CALCULATION OF REGGEON AND DIFFRACTION PARAMETERS. Balazs, L. A. P. (Purdue Univ., Lafayette, IN). Sep 1973.

From 5th topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

Reggeon and diffraction parameters are calculated for pi pi scattering using a unitarity–duality approach. The results are found to be in reasonable agreement with experiment and t equals 0 exchange degeneracy. (JFP)

25017 (UH-511-162-73, pp 35-40) SECOND CLASS CURRENTS. Nakamura, S. (Nihon Univ., Tokyo). Sep 1973.

From 5th topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

The discussion of second-class currents includes beta rays from the polarized nuclei and G parity interference effects as well as the strong meson dominance model. (JFP)

25018 (UH-511-162-73, pp 48-52) SYSTEMATIC SEARCH FOR RENORMALIZABLE THEORIES OF HEAVY VECTOR BOSONS. Levin, D. N. (Univ. of California, Los Angeles). Sep 1973.

From 5th topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

It is conjectured that every renormalizable theory of heavy vector particles is necessarily described by an internally symmetric Lagrangian. A very wide class of heavy vector boson models is studied, and one can show that every tree-unitary theory of that class must be described by an internally symmetric Lagrangian which has a spontaneously broken gauge theory, conserved current, or new hybrid form. (JFP)

25019 s-CHANNEL IMPLICATIONS OF t-CHANNEL UNITARITY. Yndurain, F. J. (Universidad Autonoma de Madrid (Spain)). Nucl. Phys., B; 92: No. 1, 51-57(16 Jun 1975).

Using t-channel unitarity in the form proposed by Mandelstam, a scaling law is rederived for the partial waves in the s-channel $\mathrm{Im} f_l(s) \simeq \sqrt{2\pi}\, e^{-i\pi\chi} s^{-\beta(\chi)\chi - 1/2}$, $\chi = ls - \frac{3}{2}$, $s \to \infty$, recently derived by Haan and Mütter. The usefulness of the equations (which, unlike the Haan-Mütter ones, are valid at finite s and not only asymptotically) for phenomenological $\pi\pi$ phase-shift analysis is emphasized. (auth)

25020 LIPKIN'S THIRD COMPONENT AND VALENCE-CORE EXCHANGE. Licht, A. L.; Pagnamenta, A. (Illinois Univ., Chicago (USA). Dept. of Physics). Nucl. Phys., B; 92: No. 1, 1-12(16 Jun 1975).

It is shown that Lipkin's third component in the hadronic total cross sections can be understood in terms of the exchange of reggeons between valence quarks and an isospin symmetric core. The reggeon-quark coupling constants are expressed as integrals over the quark distribution functions. The values for these integrals, found from the hadronic cross sections, lead to a new sum rule for deep-inelastic electron-nucleon scattering. (auth)

25021 FIXED ANGLE SCATTERING IN A FIELD THEORY MODEL OF $\bar{p}p$ ANNIHILATION. Halliday, I. G.; Huskins, J. (Imperial Coll. of Science and Technology, London (UK)). Nucl. Phys., B; 92: No. 1, 95-100(16 Jun 1975).

Two-body $\bar{p}p$ annihilation is examined at high energy and fixed angle in a model field theory of a fermion and massive neutral vector meson. In the weak coupling approximation the amplitude eikonalizes with "soft" photons dressing the hard nucleon exchange Born term, leading to an exponential fall off in $1n^2s$. (auth)

25022 THE REACTION $\bar{p}p \to 2\pi^-2\pi^+$ AT INTERMEDIATE ENERGIES. Everett, D.; Grossmann, P.; Mason, P.; Muirhead, H. (Liverpool Univ. (UK)). Nucl. Phys., B; 92: No. 1, 78-94(16 Jun 1975).

Systematic features of the channel $\bar{p}p \to 2\pi^-2\pi^+$ are examined in the antiproton momentum range 2.5 to 4.6 GeV/c. It is found that as the antiproton momentum increases exchange effects become increasingly important and a "leading pion" emerges. This pion leaves a "cluster" of three pions which preferentially decays to a pion plus a two-pion resonance (ρ,f,g mesons). The cluster is found to possess relatively weak internal directional properties. Both the leading pion and the pions in the cluster possess high transverse momenta. (auth)

25023 PHENOMENOLOGY OF THE ψ(3105) AND THE HYPOTHESIS OF CHARM. Clavelli, L.; Yang, T. C. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Phys. Lett., B; 57: No. 1, 83-86(9 Jun 1975).

The effective coupling strengths of the ψ(3105) to ordinary hadrons are estimated and the possibility that this resonance is the uncharmed vector meson ϕ_c composed predominantly of charmed quarks is examined. Distinctive decay modes of ϕ_c are pointed out. (auth)

25024 SPONTANEOUSLY BROKEN GAUGE THEORIES IN THE PHYSICAL GAUGE: EXAMPLES FOR BOSONIC PROCESSES AND RENORMALIZATION. Kainz, W.; Kummer, W.; Schweda, M. (Technische Hochschule, Vienna). Acta Phys. Austriaca; 39: No. 2, 180-192(1974).

An earlier work on the cancellation of divergences in the physical gauge of spontaneously broken gauge theories is extended to the simplest bosonic processes in the U(1)-model of Higgs. It is found that a consistent set of renormalization constants can be given. (auth)

25025 GENERATION OF BOSON PAIRS FROM A VACUUM. Bagrov, V. G.; Gitman, D. M.; Gavrilov, S. P.; Shvartsman, Sh. M. (Tomsk State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 3, 71-74(1975). (In Russian).

A general theory is constructed for the generation of pairs of particles without spin from vacuum in the presence of an electromagnetic field. It is shown that by knowing the exact solutions of the Klein-Gordon equation for particles in the given external field it is possible to solve the problem of pair generation. (tr-SJR)

Strong (Baryon No. = 1)

25026 (JINR–D1-2-8405, pp 123-129) INCLUSIVE SPECTRA OF π MESONS FROM π^-p INTERACTIONS AT 8.05, 18.5, AND 40 GeV/c. Akhababyan, N. O. (Inst. of Nuclear Physics and Nuclear Power Engineering, Sofia); Grekova, L. D.; Ikov, N. L.; Markov, P. K.; Penev, V. N.; Shklovskaya, A. I.; Semerdzhiev, Kh. I. 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25027 (JINR–D1-2-8405, pp 140-154) SOME CORRELATION PHENOMENA IN HIGH ENERGY HADRON COLLISIONS. Sabau, M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974.

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

Some results on correlation effect investigations are presented including two-particle correlation in rapidity, semi-inclusive two-particle correlations in rapidity, azimuthal correlations, and clusterization. (JFP)

25028 (JINR-D1-2-8405, pp 155-160) CORRELATED JET MODEL DESCRIPTION OF THE REACTION $\pi^+p \rightarrow p3\pi^+ 2\pi^-$ AT 8 AND 16 GeV/c. Aachen-Berlin-Bonn-CERN-Krakow-Heidelberg-Warsaw-Collaboration. 1974.

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

The correlated jet model is shown to yield a reasonable description of the reaction $\pi^+ + p \rightarrow p + 3\pi^+ + 2\pi^-$ in distributions and energy dependence. One could calculate the probabilities for the appearance of defined reaction channels in the final state and thus estimate the resonance production. (JFP)

25029 (JINR-D1-2-8405, pp 161-170) MULTIDIMENSIONAL STUDY OF CLUSTERING IN THE REACTION $\pi^+p \rightarrow p\pi^+\pi^+\pi^-$ AT 16 GeV/c. Aachen-Bonn-CERN-Krakow-Heidelberg-Warsaw-Collaboration. 1974.

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

A study of clustering of four-prong events is presented. The method used does not need any a priori knowledge about the reaction mechanisms involved. The classification of each event is done using the kinematical information contained in the whole sample of events. The clusters found are closely related to the main reaction mechanisms. The method is easily applicable also to other reaction channels. (auth)

25030 (JINR-D1-2-8405, pp 198-203) DESCRIPTION OF THE $\pi^-p \rightarrow p\pi^+\pi^-\pi^-$ IN THE REGGEIZED ONE-PION EXCHANGE MODEL AT 5 AND 16 GeV/c. Glagolev, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR); Emel'yanenko, V. N.; Lebedev, R. M.; Saitov, I. S.; Boreskov, K. G.; Ponomarev, L. A.; Patochka, I. 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25031 (JINR-D1-2-8405, pp 204-209) ANALYSIS OF THE CREATION OF ρ_0 MESONS AND Δ^{++} ISOBARS IN $\pi^-p \rightarrow p\pi^+\pi^-\pi^-$ REACTIONS IN THE OPER MODEL AT MOMENTUM OF 5 GeV/c. Glagolev, V. V.; Lebedev, R. M.; Saitov, I. S.; Boreskov, K. G.; Ponomarev, L. A.; Patochka, I. 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25032 (JINR-D1-2-8405, pp 310-315) NEW INVARIANT DESCRIPTION OF THE MEAN-QUADRATIC RADIUS OF THE NUCLEON. Skachkov, N. B. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25033 (JINR-D1-2-8405, pp 341-347) HYPERNUCLEAR RESONANCES. Kielczewska, D. (Univ. of Warsaw). 1974.

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

A review is given of experimental work on hypernuclear resonances. It is seen that further experiments with K^- mesons at rest and in flight are still necessary with better instrumental resolution to conclude about the structure and production mechanism of the hypernuclear resonances. (JFP)

25034 INCLUSIVE PROCESSES IN HADRON-NUCLEUS COLLISIONS AS A TEST FOR QUARK-PARTON MODEL. Anisovich, V. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). Phys. Lett., B; 57: No. 1, 87-89(9 Jun 1975).

The quark model describes satisfactorily not only the static properties of hadrons, but also their interaction at high energies. One discusses the relations between the total hadron-hadron cross section, the relationship between the slopes of diffraction cone and the hadron form factors at comparatively low energies, the symmetry of secondary particle spectra in meson-nucleon collisions in the c.m. system of constituent quarks. A number of results for multiparticle production in hadron-hadron collisions that are in agreement with the experimental data, have been obtained by supplementing the quark model with the parton hypothesis. The above mentioned facts can be interpreted as favoring the nucleus-like hadron model. (auth)

25035 MODEL FOR πp, Kp, AND $\bar{p}$p TOTAL CROSS SECTION RATIOS. Teper, M.; Dash, J. W.; Razmi, M. S. K. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Phys. Lett., B; 7: No. 1, 51-53(9 Jun 1975).

The ratios of πp, Kp and $\bar{p}$p total cross sections are calculated utilizing coupled homogeneous linear integral equations supplemented with SU(4) symmetry for the couplings. Kinematic effects arising from mass splittings and t_{min} effects are crucial. $\sigma_{\pi p}/\sigma_{Kp} \sim 1.7$ and $\sigma_{\bar{p}p}/\sigma_{\pi p} \sim 1/50$ are obtained. (auth)

25036 METHOD OF MULTICHANNEL ANALYSIS OF HADRON COLLISIONS EXEMPLIFIED ON THE REACTION $K^+p \rightarrow K^0\pi^+p$ AT 5 GeV/c. Ferrando, A.; Holmgren, S. O.; Korkea-Aho, M.; Montanet, L.; van Hove, L. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 92: No. 1, 61-77(16 Jun 1975).

A method for the separation of the various channels contributing to a multibody reaction is presented. Distribution functions are estimated for these channels and their possible interference effects. They are improved along the analysis by comparison to weighted distributions of events. As an example, the reaction $K^+p \rightarrow K^0\pi^+p$ at 5 GeV/c is treated with this method. (auth)

25037 BARYON-GRAVIMESON INTERACTION IN THE NONLINEAR QUARK THEORY. IV. Kurdgelaidze, D. F.; Funke, Kh. (Moscow State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 4, 91-95(1975). (In Russian).

The interaction of spin -1/2 baryons with octets of gravimesons (with spin -2 mesons) was examined in the framework of the nonlinear quark field theory. Corresponding field equations were obtained and indicate that the interaction of baryons with neutral gravimesons of the octet can effectively be described by the introduction of the metric tensor of Riemann geometry dependent on the gravimeson field. The spin-1/2 field equation takes the form of the Fok-Ivanenko equation for spinors in Riemann geometry. (tr-auth)

25038 PARTICLE EXCHANGE IN K^+p SCATTERING. Cottingham, W. N.; Davis, A. C.; Giddings, D. I. (Bristol Univ. (UK). H. H. Wills Physics Lab.). Nucl. Phys., B; 91: No. 3, 509-516(9 Jun 1975).

Recent phase-shift analyses of K^+p scattering have shown many features of particle exchange. In exotic channels, particle exchange appears to play a more prominent role than in non-exotic channels where exchanges are obscured by direct channel resonances. In the present paper particle exchange has been investigated in the momentum range 0.9 to 1.5 GeV/c, using a phase-shift analysis in which coupling constants were variable parameters. (auth)

25039 PREDICTIONS ON $\pi^-p \rightarrow \rho^0n$ IN TERMS OF COMPLEX REGGE POLES USING VECTOR-MESON DOMINANCE. Pal, B. K. (Imperial Coll. of Science and Tech., London). Acta Phys. Austriaca; 39: No. 2, 137-145(1974).

The vector-meson dominance model for the process $\pi^-p \rightarrow \rho^0n$ is related to single pion photoproduction. The longitudinal and the transverse amplitudes for the process $\pi^-p \rightarrow \rho^0n$ are obtained from single-pion photoproduction amplitudes when one assumes that the off-shell Ball amplitudes satisfy the constraints imposed by current conservation and are smooth in the vector-meson mass. Earlier work on charged pion photoproduction is applied to obtain amplitudes parametrized in terms of complex Regge poles to analyze the process $\pi^-p \rightarrow \rho^0n$. (auth)

25040 NUCLEON FORM FACTORS IN THE EXTENDED VDM SUPPLEMENTED WITH ASYMPTOTIC CONSTRAINTS. Blatnik, S.; Zovko, N. (Univ., Zagreb). Acta Phys. Austriaca; 39: No. 1, 62-75(1974).

It is shown that the asymptotic constraint $tG(t) \rightarrow 0$ as $t \rightarrow \infty$, G's being nucleon Sachs form factors, within the VDM implies the existence of at least three isovector and three isoscalar vector mesons. Such as asymptotic bound was sufficient to reduce significantly the number of free parameters and to fix all four form factors up to four free parameters only. By varying the parameters excellent agreement with all existing data is achieved. As a by-product, estimates of vector-meson-nucleon coupling constants and values of higher meson masses are obtained. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 24951 and 25097.

25041 (CONF-750654-8) DECAY PROPERTIES OF p π^- SYSTEMS PRODUCED IN NEUTRON DISSOCIATION AT FERMILAB ENERGIES. Biel, J.; Bieser, E. J.; Duke, D.; Ferbel, T.; Fretag, D.; Gobbi, B.; Kenah, L.; Rosen, J.; Ruchti, R.; Slattery, P.; Underwood, D. (Rochester Univ., N. Y. (USA); Fermi National Accelerator Lab., Batavia, Ill. (USA); Stanford Linear Accelerator Center, Calif. (USA); Northwestern Univ., Evanston, Ill. (USA)). 1975. 10p. Dep. NTIS $4.00.

From international conference on high energy physics; Palermo, Italy (Jun 1975).

The decay distributions of (p π^-) systems produced in the reaction n + p yields (p π^-) + p for neutron momenta between 120 and 300 GeV/c were examined. Preliminary analysis of decay moments indicates the presence of large helicity-flip amplitudes even for small (p π^-) mass values, and does not support the hypothesis that the helicity nonflip (p π^-) states are produced peripherally in impact parameter. These results are in approximate agreement with predictions of the Deck mechanism. The experiment was performed at the M-3 neutral beam of Fermilab. (auth)

25042 (ITP-75-39P) HYPERTRITIUM BINDING ENERGY AND THE Ad DOUBLET SCATTERING LENGTH FOR NONLOCAL POTENTIALS WITH SEPARABLE VARIABLES. Peresypkin, V. V.; Petrov, N. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

We have studied the shape effect of two-body interaction on the Λ-particle binding energy in hypertritium B_Λ and on the Ad doublet scattering length α_2^Λ. Charge symmetry of the ΛN interaction is assumed. The dependence of B_Λ and α_2^Λ on the low-energy ΛN parameters is studied. The correlation dependence between B_Λ and α_2^Λ is also investigated. (1 figure, 2 tables) (auth)

25043 (JINR-D1-2-8405, pp 183-189) DESCRIPTION OF THE pp → pp$\pi^+\pi^-$ REACTION IN THE REGGEIZED ONE-PION EXCHANGE MODEL. Ponomarev, L. A. (Inst. of Theoretical and Experimental Physics, Moscow). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25044 (JINR-D1-2-8405, pp 190-197) INVESTIGATION OF THE MECHANISM OF THE pp → pp$\pi^+\pi^-$ REACTION IN THE REGGEIZED ONE-PION EXCHANGE MODEL. Ponomarev, L. A. (Inst. of Theoretical and Experimental Physics, Moscow). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25045 (JINR-D1-2-8405, pp 348-352) AN INTERACTIONS IN THE P-SHELL HYPERNUCLEI. Zieminska, D. (Instytut Fizyki Doswiadczalnej UW, Warsaw). 1974.

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

The ΛN forces in the p-shell hypernuclei are investigated. Works in which $I(^{12}B_\Lambda)$ and the mixing angle were investigated are presented. (JFP)

25046 (ORO-3992-232) RAPIDITY GAP DISTRIBUTION AND CORRELATION FUNCTION BASED ON A B-CLUSTER MODEL. Chiu, C. B.; Wang, K. H. (Texas Univ., Austin (USA). Center for Particle Theory). 1975. Contract AT(40-1)-3992. 26p. Dep. NTIS $4.50.

A B-cluster model, which is a simple model for the independent emissions of charged and neutral clusters with M, the number of charged particles per cluster, varying from 2 to 3 is investigated. Within the model, one determines the Gaussian width sigma/sub d/ of the decay pion rapidity distribution from analysis of rapidity gap distribution and the charged-particle correlation function data. It is found that for M approximately 3 and sigma/sub d/ approximately 1, the model is compatible with these data and also with the charge transfer data considered in an earlier work. (auth)

25047 STUDY OF THE LOW-MASS DIFFRACTIVE SYSTEM PRODUCED IN pp COLLISIONS AT 12 AND 24 GeV/c. Blobel, V.; Fesefeldt, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Eskreys, A.; Franz, H.; Lamsa, J. W.; Schmitz, N.; Treffeisen, W. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)); Von Holt, K.; Idschok, U.; Roedel, R. (Bonn Univ. (F. R. Germany). Physikalisches Inst.). Nucl. Phys., B; 92: No. 2, 221-240(23 Jun 1975).

An analysis of the decay of the low-mass diffractive system X produced in the reaction pp → p + X at 12 and 24 GeV/c is presented. The various decay channels of the system have been separated; the decay multiplicity distribution is investigated and compared with the expectations of a two-step picture of diffraction dissociation. A comparison of virtual Pomeranchuk particles with on-shell γp and pp processes is discussed. (auth)

25048 CONSTRAINTS ON THE ASYMPTOTIC BEHAVIOR OF TOTAL CROSS SECTIONS. Jakob, H. P. (European Organization for Nuclear Research, Geneva (Switzerland)); Kroll, P. (Karlsruhe Univ. (TH) (F.R. Germany). Inst. fuer Theoretische Kernphysik). Nucl. Phys., B; 92: No. 1, 171-188(16 Jun 1975).

Constraints on the asymptotic behavior of total cross sections are derived which follow from dispersion relations and measured real parts of the forward scattering amplitudes. For πN and pp scattering, these constraints are calculated using recent results from FNAL and Serpukhov. The relation to other methods is discussed. (auth)

25049 MODEL DEPENDENCE OF THE COLOUMB-CORRECTED p-p SCATTERING LENGTH. de Groot, H.; Boersma, H. J. (Vrije Universiteit, Amsterdam (Netherlands). Natuurkundig Lab.). Phys. Lett., B; 57: No. 1, 21-23(9 Jun 1975).

It is shown that the requirement of a fixed intermediate-range $^1S_0$ proton-proton interaction considerably reduces the model dependence of the Coulomb-corrected p-p scattering length. A possible relation with the off-shell effective range parameter is discussed. (auth)

25050 DEUTERON IN A BAG MODEL OF HADRONS. Fairley, G. T.; Squires, E. J. (Durham Univ. (UK)). Nucl. Phys., B; 93: No. 1, 56-60(14 Jul 1975).

A simple prescription for quantising a six-quark bag is proposed. Calculations in one dimension appear to give the right order of magnitude for the effective nucleon-nucleon potential. (auth)

25051 CORRELATION EFFECTS IN MULTIPLE PRODUCTION OF PARTICLES. Azimov, S. A.; Bondarenko, A. I.; Gulamov, K. G.; Riskiev, T. T.; Chernova, L. P.; Chernov, G. M. (Physical-Technical Inst., Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 56-61(1975). (In Russian).

A general method is presented for analyzing correlations in individual multiple production events. The method was applied to experimental data for energies of 20 to 200 GeV/c. A strong tendency of particles to fragment, increasing with increasing energy, at low n values was demonstrated. Indications were obtained of an increase in the cross section for diffraction production of particles with energy or increased contribution of these processes in events with a fixed n value. (3 figures) (tr-auth)

25052 CONSTRAINT ON THE OFF-SHELL EFFECTIVE RANGE PARAMETER IN p-p SCATTERING. Sprung, D. W. L.; Srivastava, M. K. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics). Nucl. Phys., A; 244: No. 2, 315-321(9 Jun 1975).

Sauer has recently proposed fixing the zero-energy $^1S_0$ state wave function as a means of constraining the off-shell behavior of the N-N interaction. As an alternative it is proposed that the value of the off-shell effective range parameter I_0 be constrained. A value of $I_0 = 13 \pm 1$ fm^3 seems to be indicated if charge symmetry is required. (auth)

25053 RESTRICTIONS ON THE CLUSTER DECAY MULTIPLICITY DISTRIBUTION IN THE INDEPENDENT CLUSTER EMISSION MODEL DUE TO CROSSING SYMMETRY AND ISOSPIN INVARIANCE. Plaut, G.; Redei, L. B. (Nice Univ., 06 (France). Lab. de Physique Theorique). Nucl. Phys., B; 91: No. 3, 432-444(9 Jun 1975).

Multiparticle production in high energy proton-proton scattering is discussed under the assumption that all produced secondaries are pions. The pion isospin is taken into account but the isospin of the protons is neglected. In the first part of the paper it is shown that the multiplicity distribution of the independent cluster emission model can be derived from a unitary, crossing symmetric, isospin invariant, impact parameter model. This part is a straightforward generalization of a previous work where similar results were obtained for isospin-zero mesons. In the second part of the paper the restrictions on the cluster decay multiplicity distribution due to crossing symmetry in the meson variables and to isospin invariance is discussed. In particular, a non-trivial lower bound is derived for the dispersion of the charged particles in the cluster decay multiplicity distribution. (auth)

25054 DOES THE GLAUBER MODEL FAIL IN LARGE ANGLE πd SCATTERING AT HIGH ENERGIES. Zovko, N. (Karlsruhe Univ. (TH) (F.R. Germany). Inst. fuer Theoretische Kernphysik). Nucl. Phys., B; 91: No. 3, 517-526(9 Jun 1975).

It is shown that, contrary to general belief, the uncertainties in the πN amplitudes are sufficient to account for the discrepancy between the Glauber model and the data for high energy πd elastic scattering at large angles. The essential point is that the πd differential cross section in this kinematic region depends on the fourth power of the πN amplitudes and that, therefore, rather small changes in these amplitudes cause large effects in the πd cross section. Working with leading terms only it is found that more recent solutions for πN amplitudes (which are smaller in magnitude than those used in earlier analyses) may restore the agreement of theory and experiment at large angles. (auth)

Particle Invariance Principles and Symmetries

General

25055 (JINR-D1-2-8405, pp 370-373) MODEL OF THE VIOLATION OF CPT INVARIANCE. Valuev, B. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25056 ANALOGY BETWEEN SUPERCONDUCTIVITY AND CHIRAL SYMMETRY BREAKDOWN IN THE COULOMB GAUGE. Aurilia, A. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 92: No. 2, 241-268(23 Jun 1975).

Spontaneously broken gauge theories which do not explicitly involve boson fields are studied. The work was motivated by, and justifies, some recent results pointing to a deep analogy between particle physics and superconductivity. The BCS theory of superconductivity, including Coulomb effects, is compared with its relativistic generalization in the Coulomb gauge. The structure of the resulting equations is identical in both cases. The unity is best appreciated in terms of the Schwinger mechanism which leads to plasma oscillations in superconductivity and to massive spin-one particles in the relativistic case. The physical operator densities, such as charge and current densities, differ from those found by other authors concerned with the problem of gauge invariance. (auth)

25057 COMPLETE BPHZ VERSION OF THE SUPERSYMMETRY AND BROKEN CHIRAL SYMMETRY MODEL. Piguet, O. (European Organization for Nuclear Research, Geneva (Switzerland)); Schweda, M. (Technische Hochschule, Vienna (Austria). Inst. fuer Theoretische Physik). Nucl. Phys., B; 92: No. 2, 334-364(23 Jun 1975).

It is shown, using BPHZ renormalization techniques, that the Wess and Zumino supersymmetric scalar model can be renormalized such that supersymmetry and broken chiral invariance are preserved. In particular, the broken chiral Ward indentities for Green functions turn out to be free of anomalies. This fact is directly related to properties of the Callan-Symanzik functions discovered by Ferrara, Iliopoulos and Zumino. A notation in which the components of the superfields are displayed explicitly is used first, whereas a supersymmetric notation is employed at the end in order to exhibit the results in a more compact form. (auth)

25058 RENORMALIZATION GROUP FIXED POINTS IN YUKAWA THEORIES. Bailin, D.; Love, A.; Spathis, G. (Sussex Univ., Brighton (UK). School of Mathematical and Physical Sciences). Nucl. Phys., B; 93: No. 1, 165-175(14 Jul 1975).

The Callan-Symanzik functions of Yukawa theories in which the scalar mesons transform as the regular representation of SU(3), SU(2), or U(1) are calculated in two-loop order. An attractive renormalization group fixed point away from the origin is found, but at a distance such that perturbation theory cannot be considered reliable. (auth)

Applications (Electromagnetic and Weak)

25059 PARITY-VIOLATING NUCLEAR INTERACTIONS. Tadic, D. (Univ., Zagreb). pp 101-195 of Some Topics in Weak Interactions. Zaragoza, Spain; Universidad de Zaragoza (1974).

From proceedings of the V gift seminar in theoretical physics; Zaragoza, Spain (3 Jun 1974). See CONF-7406106-.

The nuclear aspects of weak interaction theory are considered with emphasis placed on second-class currents and parity-violating nuclear forces. (JFP)

25060 PROBLEMS OF CP AND T SYMMETRIES. Kabir, P. K. (Univ. of Virginia, Charlottesville). pp 229-252 of Some Topics in Weak Interactions. Zaragoza, Spain; Universidad de Zaragoza (1974).

From proceedings of the V gift seminar in theoretical physics; Zaragoza, Spain (3 Jun 1974). See CONF-7406106-.

The current status of CP-noninvariance is reviewed and the importance of a direct test of T-invariance is noted. Theories of weak interactions incorporating CP-noninvariance are discussed, with particular reference to gauge theories. Predictions are compared for the value of the neutron electric dipole moment, an important indicator of T-noninvariance, in various theories. The possibility that the observed CP-noninvariance may be a consequence of spontaneous symmetry-breaking, with or without the Higgs mechanism, is considered, as well as the suggestion that CP-noninvariance may have a cosmological origin. (auth)

25061 K → 2π DECAYS, CP VIOLATION AND BROKEN SU(3). Abad, J. (Univ., Zaragoza, Spain); Morales, A.; Nunez-Lagos, R. Acta Phys. Austriaca; 39: No. 1, 41-61(1974).

Neutral kaon decays into two pions were analyzed, in a CP violation model taking into account broken unitary symmetry. The usual current algebra and PCAC techniques are employed. Due to the current-current form assumed for the breaking SU(3) medium strong hamiltonian, the relevant weak amplitudes are related to masses and form factors. Use is made of the asymptotic symmetry of Oneda and Matsuda. A solution for the CP-violation parameter of the model (ω) and the symmetry breaking parameter (γ) which fits the experimental data are given. (auth)

Applications (Strong)

25062 BARYON NUMBER AND SUPERSYMMETRY. Grosser, D. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., B; 92: No. 1, 120-124(16 Jun 1975).

In a theory with nonvanishing masses the general structure of the pseudo Lie algebra of generators of symmetries and supersymmetries is considerably restricted if there is a supermultiplet in which the baryon number is zero for bosons and ±1 for fermions. In such a supermultiplet the highest spin is an integer spin. If the generators of SU(2) or SU(3) appear among the elements of the pseudo Lie algebra and commute with baryon number then they commute with the generators of supersymmetries. (auth)

Scattering Theory

Refer also to abstract 25208.

25063 (JINR-D1-2-8405, pp 285-290) SCATTERING ON SMOOTH POTENTIALS AT HIGH ENERGIES AND SMALL ANGLES. Atanasov, A. A. (Plovdiv Univ., Bulgaria). 1974. (In Russian).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25064 (JINR-D1-2-8405, pp 291-297) REPRESENTATION OF THE HIGH SINGULAR PARTS OF THE TWO-PARTICLE MATRIX ELEMENT $\langle \pi^+(p')/[A^1_{\frac{1}{2}} + 12/(x), A^1_{\frac{1}{2}} 15/(o)]/K^+(p)\rangle$ IN THE FORM OF DELAYED FUNCTIONS. Fakirov, D. G. (Inst. of Nuclear Research and Nuclear Power Engineering, Sofia). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25065 (JINR-D1-2-8405, pp 305-309) SPACE OF THE LOBACHEVSKII AND THREE-DIMENSIONAL POTENTIAL FORM OF THE RELATIVISTIC AMPLITUDE OF ONE-BOSON EXCHANGE. Skachkov, N. B. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25066 (JINR-D1-2-8405, pp 316-320) LOWER LIMITS FOR SCATTERING AMPLITUDES. Vernov, Yu. S.; Mnatsakanova, M. N. 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25067 (JINR-D1-2-8405, pp 321-325) CONSTRAINT ON THE FORWARD SCATTERING AMPLITUDE AT FINITE ENERGIES. Vernov, Yu. S. 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25068 (ORO-3992-229) CALLAN-SYMANZIK EQUATION IN GRIBOV'S REGGEON FIELD THEORY AND THE RENORMALIZED POMERON INTERCEPT. Acharya, R. (Texas Univ., Austin (USA). Center for Particle Theory). Aug 1975. 9p. Dep. NTIS $4.00.

The Callan-Symanzik equation is utilized within the framework of Gribov's Reggeon field theory to prove that a bare Pomeron of unit intercept necessarily restricts the renormalized Pomeron to satisfy the same condition, i.e., alpha/sub renorm./(0) equals 1, at a nontrivial fixed point beta (g*) equals 0 of the Callan-Symanzik equation. The proof of this assertion does not depend on the validity of the epsilon expansion (epsilon equals 4-D). (auth)

25069 RENORMALIZATION POINT INVARIANCE, TWISTED FANS, AND CRITICAL EXPONENTS AT FINITE EPSILON IN THE REGGEON CALCULUS. Dash, J. W. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science); Harrington, S. J. (Washington Univ., Seattle (USA). Dept. of Physics). Phys. Lett., B; 57: No. 1, 78-82(9 Jun 1975).

A procedure for calculating critical exponents directly at finite ϵ is proposed. It relies on the invariance of the critical exponents at the critical coupling g_c of the full theory with respect to finite changes in the renormalization point. This is expressed as the coincidence of curves at the point $\beta = 0$ in the plane of β versus a critical exponent parametrically described by the renormalized coupling for various values of the renormalization point (the "twisted fan"). If more than one critical exponent is present the fan is a set of curves in a multidimensional space with the twist at $\beta = 0$ and the exact values of the critical exponents. In perturbative approximations, an approximate invariance may result whether or not a zero or β exists to that order. It is shown that in the one and two loop approximations to the Reggeon calculus this approximate invariance does occur. The values of the critical exponents at the approximate twists show remarkable stability properties. $\alpha_{tot} \sim (\ln s)^{-\gamma}$ where $-\gamma \sim 0.11$ and 0.17 for one and two loops, respectively, is obtained. (auth)

25070 REGGE PARAMETERS FROM DUALITY AND UNITARITY. Chan, H. M. (Science Research Council, Chilton (UK). Rutherford Lab.); Paton, J. E.; Tsou, S. T.; Ng, S. W. (Oxford Univ. (UK). Dept. of Theoretical Physics). Nucl. Phys., B; 92: No. 1, 13-36(16 Jun 1975).

From s-channel unitarity, two coupled integral equations are derived for the reggeon and pomeron propagators using a method developed in an earlier work. The first (R) is a consistency equation constraining the reggeon parameters, while the second (P) gives the pomeron trajectory in terms of the solutions of the first. Starting then from the empirical information on the reggeon intercept ($\alpha_R \sim 0.5$) and the t-dependence of the triple-reggeon vertex obtained in inclusive reactions, one is able to calculate the strength of reggeon couplings g and the parameters of the pomeron by solving these equations. Two approximate solutions are given, one asymptotically and one at finite energies. The first gives g = 8.6, $\alpha p(0) = 1.12$ and $\alpha' p(0)$ 0.1 GeV^{-2} while the second gives g = 7.0, $\alpha p(0) = 0.95$ and $\alpha' p(0) = 0.5$ GeV^{-2}. These are to be compared with the empirical values $g \sim 6.3$, $\alpha p(0) \sim 1.0$ and $\alpha' p(0) \sim 0.25$ GeV^{-2}. In addition, one predicts the relative normalization of the pomeron and reggeon propagators at t = 0 to be P/R = 1.0 which is quite close to the values between 0.9 and 1.2 obtained from phenomenological fits to α_T. The pomeron pole is generated here as the shadow of amplitudes which are dominated by the multiperipheral production of resonant clusters. A crude estimate with this solution yields at NAL-ISR energies an average charge multiplicity of about 2.3 per cluster as compared with the value of 2.2 ± 0.2 obtained from a recent experiment. (auth)

25071 SHRINKAGE, COMPLEX POLES, AND THE CHOU-YANG MODEL. Tuan, R. H. (Paris-11 Univ., 91 - Orsay (France). Lab. de Physique Theorique et Hautes Energies). Nucl. Phys., B; 92: No. 1, 141-157(16 Jun 1975).

The shrinkage of the diffraction peaks is reproduced by the interference of a geometric pomeron and of complex poles representing S-channel threshold effects (like heavy pair production). Asymptotically, one recovers the Chou and Yang model. The shrinkage is expected to stop at $P_{lab} \simeq 10^5$ GeV/c. The total cross section σ_T is conjectured to have a maximum of 45 to 48 mb (for pp) at about the same energy where the shrinkage stops. The asymptotic value of σ_T would only differ from the maximum value by about 1 mb. The break structure at $|t| \simeq 1.2$ GeV^2/c^2 seen at low energies for pp elastic scattering is explained in terms of secondary Regge exchanges only. At high energies, the dip at $|t| \sim 1.3-1.4$ GeV^2/c^2 is given by the geometric pomeron. Because of the eikonalization procedure one obtains an intermediate $|t|$ shrinkage and a dip displacement in good agreement with experiment. (auth)

25072 QUANTUM NUMBER TRANSFER AND OVERLAP CALCULATIONS. Grassberger, P.; Miettinen, H. I. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 92: No. 2, 309-326(23 Jun 1975).

The relationship between Regge behavior of two-body amplitudes and quantum number exchange in multiparticle production is analyzed. An exact bound on the elastic forward peak in terms of inclusive transverse momentum correlations is given. Another result is that one cannot obtain $\alpha'_Q > \alpha'_P$ from overlap calculations, using only the present inclusive data as input. (auth)

25073 OFF-SHELL STATES IN DUAL RESONANCE THEORY. Corrigan, E. (European Organization for Nuclear Research, Geneva (Switzerland)); Fairlie, D. B. (Durham Univ. (UK)). Nucl. Phys., B; 91: No. 3, 527-545(9 Jun 1975).

Off-shell states are discussed with the guidance of an analogue model approach. This leads to a more complete understanding of a model proposed recently by Schwarz with critical dimension 16. Algebraic considerations lead to off-shell states in the Neveu-Schwarz-Ramond model, which obey the gauge conditions in the same critical dimension as the on-shell theory, the amplitudes factorizing on the usual positive definite states in 10 dimensions. Brief calculations reveal that some of the divergences present in the orbital model disappear in the fermion theory. (auth)

25074 ELECTRON SCATTERING FROM ATOMS, NUCLEI, AND NUCLEONS. West, G. B. (Stanford Univ., Calif. (USA). Inst. of Theoretical Physics). Phys. Rep.; 18: No. 5, 263-323 (Jun 1975).

The recent interest in deep inelastic electron scattering at ultra-high energies is reviewed in an historical context. An attempt is made to unify the quark-parton model with the conventional description of electron scattering from atoms and nuclei. New ways of looking at these nonrelativistic systems which can be motivated by ideas that have been useful in understanding the nucleon are stressed. Similarly it is emphasized how intuition gleaned from nuclear physics can be used to discuss the quark parton model. Hence, non-relativistic versions of the Bjorken scaling phenomenon, the operator product formalism, etc., are derived; we show how such formalisms can be used experimentally in atomic and nuclear physics to gain insight into single particle density distributions, two-particle correlation functions, etc. In discussing the quark-parton model of the nucleon the crucial role played by relativity is emphasized; the various techniques which have been used are reviewed in light of the non-relativistic discussion. The presentation is at a fairly modest level of sophistication with algebraic manipulations and complications (due, for example, to spin, etc.) minimized. It is hoped that it will be readable by atomic, nuclear or high energy physicists; although it has been written with the experimentalist and graduate student in mind. It is hoped that the "expert" can also learn from it. (auth)

PHYSICS (LOW-TEMPERATURE)

Superconductivity

Refer also to abstracts 24553, 24635, 24637, 24653, 24654, and 24695.

25075 (IS-3638) FLUX DENSITIES IN A TYPE-II SUPERCONDUCTING SLAB IN AN INCREASING OR DECREASING PARALLEL APPLIED MAGNETIC FIELD. Clem, J. R. (Iowa State Univ. of Science and Technology, Ames (USA)). Jul 1975. Contract W-7405-eng-82. 21p. Dep. NTIS $4.25.

The time-dependent flux densities in a type-II superconducting slab in an increasing or decreasing parallel applied magnetic field are calculated, taking into account bulk and surface pinning currents as well as induced eddy currents. (4 figures (auth)

25076 (JINR-P4-8907) MODEL FOR SUPERCONDUCTORS WITH PEIERLS-TYPE INSTABILITY. Brankov, I. G.; Tonchev, N. S. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 29p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

An exactly soluble model of a single-band metal is investigated in which the BCS-type electron–electron interaction is taken into account as well as the Frohlich interaction, with a singled-out phonon mode, driving the structural phase transition. The spectrum of the quasi-particle excitations is discussed in detail, and the free energy density is calculated. (auth)

25077 SPIN SPLITTING OF THE DENSITY OF ELECTRONIC STATES OF THIN SUPERCONDUCTORS IN MAGNETIC FIELD. Moskalenko, V. A.; Vladimir, M. I. (Institute of Applied Physics of the Academy of Sciences of USSR, USSR). Phys. Lett., A; 53: No. 2, 131-132(2 Jun 1975).

The spin splitting of the density of states of a thin superconducting film in a parallel magnetic field was investigated. The analytical expression for the density of states in the limit case of impurity parameters of theory β on the order of $\alpha^2 \ll 1$ is obtained for different energetical intervals. The expression for the energy gap ω_g is also given. (auth)

PHYSICS (NUCLEAR)

25078 (IPNO-1973) 1973 ANNUAL REPORT. (Paris-11 Univ., 91- Orsay (France). Inst. de Physique Nucleaire). 1973. 369p. (In French). Dep. NTIS (US Sales Only) $21.50.

This report contains contributions from the Division of Nuclear Physics, Division of High-energy Physics, Division of Radiochemistry, and Division of Theoretical Physics, as well as a section on technical research. Most of the contributions are about a page in length. Some of these contain data, especially in the nuclear physics section; however, with over 200 references to publications, etc., one may assume that more extensive accounts of the research are available elsewhere. (RWR)

Neutron Interactions with Matter

Refer also to abstracts 24924 and 25163.

25079 (AEC-tr-7314, pp 54-59) ATTENUATION OF THE NEUTRON FLUX DUE TO THE ABSORPTION IN SOLUTION AND ITS EFFECT ON THE RESULTS OF NEUTRON ACTIVATION ANALYSIS OF SOLUTIONS. Kazachenkov, Yu. N.; Karatashev, E. R.; Chulkin, V. L.; Shtan, A. S. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The expression for the value of thermal neutron flux in a solution containing elements with high cross sections for thermal neutrons is obtained by treating the absorption of neutrons as equivalent to the effect of uniformly distributed "negative" neutron sources in the solution. Equations for correction of the effect of elements other than the ones of interest in activation analysis solutions are derived. (GHT)

25080 (ANCR-1206) MIXED ZONE GEOMETRY OPTION FOR THE RAFFLE GENERAL PURPOSE MONTE CARLO CODE. Marsden, R.S.; Wheeler, F. J.; Wessol, D. E. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Feb 1975. Contract AT(10-1)-1375. 32p. Dep. NTIS $4.00.

A mixed zone geometry option for the RAFFLE general purpose Monte Carlo code is described, and instructions for preparation of the input data for this option are presented. This option simplifies preparation of the zone geometry input for problems having an array of fuel pins. (auth)

25081 (CINDA-75(Vol.1)) INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA. Volume 1. Z Less than or Equal to 52. (International Atomic Energy Agency, Vienna (Austria)). 1 Apr 1975. 1033p. IAEA (2 Vols. and a Suppl. $58.00).

CINDA, the Computer Index of Neutron Data, contains bibliographical references to measurements, calculations, reviews, and evaluations of neutron cross sections and other microscopic neutron data; it includes also index references to computer libraries or numerical neutron data exchanged between the four regional neutron data centers. CINDA 75 is a cumulative issue in two volumes, and supersedes all earlier issues. It contains the complete CINDA file as of 1 April 1975. This volume contains nuclides with $Z \leq 52$. (RWR)

25082 (CINDA-75(Vol.2)) INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA. Volume 2. Z Greater than or Equal to 53. (International Atomic Energy Agency, Vienna (Austria)). 1 Apr 1975. 987p. IAEA (2 Vols. and a Suppl. $58.00).

CINDA 74 is a cumulative issue which contains the complete CINDA file as of 1 April 1975 and supersedes all earlier issues. This volume contains nuclides with $Z \geq 53$ as well as several appendixes. (RWR)

25083 (JINR-P3-8795) EFFECT OF THE MEDIUM CRYSTALLINITY AND OF THE SURFACE ROUGHNESS ON THE ULTRACOLD NEUTRON REFLECTION. Ignatovich, V. K.; Lushchikov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 31p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

Reflection of ultracold neutrons (UCN) from the crystalline medium has been considered using the method of multiple wave scattering in order to clear up the possibility of UCN penetrating through the crystalline medium with the probability $(d/\Lambda)^2$, where d is interatomic distance, Λ is the UCN wavelength. It is shown that the penetration does not take place. The formulae are derived for the influence of surface roughnesses on the absorption coefficient, applicable in a wide range of roughnesses parameters. (auth)

25084 (JINR-P4-8851) POSSIBLE CAUSE OF ANOMALY IN STORAGE TIME OF ULTRACOLD NEUTRONS. Frank, I. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 15p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A possibility is considered for explanation of an anomalously short time of UC neutron storage in the experimental systems as a result of neutron heating caused by neutron diffraction on moving surface waves in matter. (2 figures) (auth)

25085 (KFK-2108) GRUCAL, A COMPUTER PROGRAM FOR CALCULATING MACROSCOPIC GROUP CONSTANTS. Woll, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Jun 1975. 96p. (In German). Dep. NTIS (US Sales Only) $8.00

Nuclear reactor calculations require material- and composition-dependent, energy averaged nuclear data to describe the interaction of neutrons with individual isotopes in material compositions of reactor zones. The code GRUCAL calculates these macroscopic group constants for given compositions from the material-dependent data of the group constant library GRUBA. The instructions for calculating group constants are not fixed in the program, but will be read at the actual execution time from a separate instruction file. This allows to accomodate GRUCAL to various problems or different group constant concepts. (auth)

25086 (ORNL-TM-4847) CROSS SECTION AND METHOD UNCERTAINTIES: THE APPLICATION OF SENSITIVITY ANALYSIS TO STUDY THEIR RELATIONSHIP IN RADIATION TRANSPORT BENCHMARK PROBLEMS. Weisbi, C. R.; Oblow, E. M.; Ching, J.; White, J. E.; Wright, R. Q.; Drischler, J. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 74p. (ENDF-218). Dep. NTIS $6.75.

Sensitivity analysis is applied to the study of an air transport benchmark calculation to quantify and distinguish between cross-section and method uncertainties. The boundary detector response was converged with respect to spatial and angular mesh size, P/sub 1/ expansion of the scattering kernel, and the number and location of energy grid boundaries. The uncertainty in the detector response due to uncertainties in nuclear data is 17.0 percent (one standard deviation, not including uncertainties in energy and angular distribution) based upon the ENDF/B-IV "error files" including correlations in energy and reaction type. Differences of approximately 6 percent can be attributed exclusively to differences in processing multigroup transfer matrices. Formal documentation of the PUFF computer program for the generation of multigroup covariance matrices is presented. (47 figures, 14 tables) (auth)

25087 (UJV-3454R) METHOD OF CUMULATIVE FACTORIZATION USED TO SOLVE A SYSTEM OF LINEAR DIFFERENTIAL EQUATIONS OF THE SECOND ORDER WITH TRANSITION CONDITIONS APPROXIMATELY. Tinka, I. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Jan 1975. 10p. Dep. NTIS (US Sales Only) $4.00.

Some physical problems lead to the solving of a system of linear differential equations of the second order with piecewise constant coefficients and prescribed transition conditions at some points of the interval considered. The paper contains a formulation of the problem and a description of the method of cumulative factorization, modified with respect to the problem with transition conditions, the advantage being, as compared to other approximate methods of solution, that the requirements with regard to the storage capacity of the computer are minimum. The problem of this type was generated in solving a system of multi-group diffusion equations in the theory of nuclear reactors. A simple numerical example is given for illustration. (auth)

25088 NEUTRON SCATTERING BY LASER PHOTONS IN CRYSTALS. Agranovich, V. M.; Lalov, I. I. (AN SSSR, Moscow. Inst. Spektroskopii). Phys. Lett., A; 53: No. 2, 169-170(2 Jun 1975).

It is shown that in crystals neutron-photon interaction increases drastically. Due to the fact that photon propagation in a crystal involves nuclear movement, the cross section of neutron scattering by photons appears to be proportional to the cross section of neutron scattering by nuclei. (auth)

25089 SUPER-THERMAL SOURCES OF ULTRA-COLD NEUTRONS. Golub, R.; Pendlebury, J. M. (Sussex Univ., Brighton (UK). School of Mathematical and Physical Sciences). Phys. Lett., A; 53: No. 2, 133-135(2 Jun 1975).

Some systems are discussed in which the steady state UCN density corresponds to "temperatures" much lower than the temperature of the moderator, contrary to the generally accepted view that this cannot occur. (auth)

Nuclear Properties and Reactions, A ≤ 5

25090 (UH-511-162-73, pp 27-31) MUON NUCLEON DEEPLY INELASTIC SCATTERING AT BNL AND NAL (EXP 98). Kirk, T. (Univ. of Illinois, Urbana). Sep 1973.

From 5th topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

An experiment to scatter muons from liquid hydrogen, deuterium, and heavy elements at energies around 7.2 GeV and q^2 approximately 1 $(GeV/c)^2$ is discussed. Cross sections and structure functions are plotted. (JFP)

25091 POLARIZATION OF NEUTRONS FROM THE d–d REACTION AT DEUTERON ENERGIES BETWEEN 50 AND 700 keV. Sikkema, C. P.; Steendam, S. P. (Rijksuniversiteit Groningen (Netherlands)). Nucl. Phys., A; 245: No. 1, 1-12 (23 Jun 1975).

The polarization of neutrons from the reaction $^2H(d,n)^3He$ has been measured with unpolarized incident particles and target nuclei. A new type of helium recoil polarimeter is used. The results indicate a monotonic increase of the degree of neutron polarization P_n with increasing deuteron energy E_d in the range 50-700 keV. Typical values are $P_n = -0.099, -0.126, -0.162$ and -0.173 for $E_d = 52, 154, 268$ and 586 keV, respectively, and a neutron emission angle of 52-53° in the c.m. system. The measured dependence of P_n on E_d approximately agrees with the energy dependence calculated from measured anisotropies of the neutron angular distribution by means of the theoretical relations of Blin-Stoyle and Boersma. (auth)

25092 PHOTOPRODUCTION OF NEUTRAL PIONS ON DEUTERIUM AT FORWARD ANGLES IN THE FIRST RESONANCE REGION. Hilger, E.; Roegler, H. J.; Simons, L. M.; Tonutti, M. (Bonn Univ. (F. R. Germany). Physikalisches Inst.). Nucl. Phys., B; 93: No. 1, 7-11(14 Jul 1975).

At the 500 MeV electron synchrotron in Bonn differential cross sections of the reaction $\gamma + d \rightarrow \pi^0 + d$ were measured in forward pion c.m. angles and photon energies between 340 and 420 MeV. (auth)

25093 PION–He SCATTERING. Landau, R. H. (British Columbia Univ., Vancouver (Canada). Dept. of Physics). Phys. Lett., B; 57: No. 1, 13-16(9 Jun 1975).

Pion scattering from ^3He and ^4He is calculated with a realistic theoretical optical potential. The ^4He results agree well with data and the ^3He results indicate a significant sensitivity to the magnetic moment form factor. (auth)

25094 NEUTRON TOTAL CROSS SECTIONS ON NUCLEI AT FERMILAB ENERGIES. Murthy, P. V. R.; Ayre, C. A.; Gustafson, H. R.; Jones, L. W.; Longo, M. J. (Michigan Univ., Ann Arbor (USA)). Nucl. Phys., B; 92: No. 2, 269-308(23 Jun 1975).

Total cross sections have been measured for neutrons on protons, deuterium, beryllium, carbon, aluminum, iron, copper, cadmium, tungsten, lead, and uranium for momenta between 30 and 300 GeV/c. The measurements were carried out in a small-angle neutral beam at Fermilab. Typical accuracy of the data is 0.5 to 1%. The cross sections are consistent with an $A^{0.77 \pm 0.01}$ dependence over the entire momentum range. The cross sections are compared with theoretical predictions. Agreement is found only if inelastic screening is included. Nuclear radii obtained from the data are in good agreement with previous determinations. (auth)

25095 SIMULATION OF A DOUBLE-SCATTERING POLARIZATION EXPERIMENT WITH FAST NEUTRONS BY MEANS OF MONTE CARLO CALCULATIONS. Tornow, W.; Spiegelhauer, H.; Mack, G. (Tuebingen Univ. (F. R. Germany). Physikalisches Inst.). Nucl. Instrum. Methods; 125: No. 3, 373-389(15 Apr 1975).

Monte Carlo techniques were used to calculate asymmetry values of a fast-neutron double-scattering experiment with ^4He scintillators, recently performed to compare the experimental results with predictions resulting from various n-^4He phase-shift sets. Effects of finite geometry, the influence of scintillator walls and shieldings, and the influence of multiple scattering on helium, xenon, and iron including polarization effects were taken into account. Recoil spectra of the ^4He scatterers and time-of-flight spectra of the scattered neutrons were calculated. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 25094 and 25142.

25096 (JINR-D1-2-8405, pp 224-228) MEASUREMENT OF THE ASYMMETRY OF THE QUASI-ELASTIC SCATTERING OF POLARIZED 635-MeV PROTONS BY ^6Li AND ^{12}C. Nadezhdin, V. S.; Petrov, N. I.; Satarov, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25097 (JINR-P1-8977) SPECTRA OF PROTONS EMITTED IN BACKWARD DIRECTION IN 5-GeV/c π^--MESON INTERACTIONS WITH C NUCLEI. Budagov, Yu. A.; Valkar, Sh.; Vinogradov, V. B. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

By using the data from the pictures from a 1-meter propane chamber exposed to a π^--meson beam (P = 5 GeV/c), a test was made for the universality of the structure function $f = (1/\sigma_{tot})(E/p^2)(d^2\sigma/dpd\Omega)$ for protons emitted in the backward direction in the lab coordinate system in the reaction $\pi\, C \rightarrow P_s + \ldots$. It follows from experimental data that the angular dependence must be introduced into the structure function parametrization. The results are given for the best of the tested parametrizations $f = A_0 \exp - (A_1 + A_2 \cos^2\theta)p^2$. (3 figures, 3 tables) (auth)

25098 (LA-5983-MS) MORE 14-MeV, NEUTRON-INDUCED GAMMA-RAY PRODUCTION CROSS SECTIONS. Drake, D. M.; Arthur, E. D.; Silbert, M. G. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1975. Contract W-7405-ENG-36. 9p. Dep. NTIS $4.00.

A pulsed 14.2-MeV neutron source and NaI(Tl) gamma-ray spectrometer were used to measure gamma-ray production cross sections for beryllium, carbon, magnesium, aluminum, silicon, calcium, titanium, vanadium, chromium, iron, copper, niobium, molybdenum, thorium, and ^{238}U. (4 tables) (auth)

25099 (UH-511-162-73, pp 44-47) DIFFRACTION DISSOCIATION OF NEUTRONS ON NUCLEI. Longo, M. J. (Univ. of Michigan, Ann Arbor). Sep 1973.

From 5th topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

The reaction n + A yields n^* + A yields $(p + pi^-)$ + A, where A was a carbon, copper, or lead nucleus, was studied. The energy of the reaction centered at about 25 GeV/c. Mass and angular distributions and cross sections are found. There is a possible production of DELTA(1236) on lead. (JFP)

25100 FINAL STATE INTERACTION AND DIRECT FEATURES OF THE $^9Be(\tau,\alpha)\alpha\alpha$ AND $^{10}B(d,\alpha)\alpha\alpha$ REACTIONS. Roy, R.; Birchall, J.; Frois, B.; Von Moellendorff, U.; Lamontagne, C. R.; Slobodrian, R. J. (Laval Univ., Quebec City (Canada). Dept. de Physique). Nucl. Phys., A; 245: No. 1, 87-106(23 Jun 1975).

Alpha-particle spectra and α-α correlations have been measured from the $^9Be(\tau,\alpha)\alpha\alpha$ and $^{10}B(d,\alpha)\alpha\alpha$ reactions at several energies between 2.9 and 10.0 MeV. Significant differences in the spectra from the reactions were observed at equal c.m. energies and momentum transfer values. However the continuous energy spectra have been successfully analyzed with two-body interactions as obtained from elastic α-α scattering, within a formalism adequate for a three-body state. DWBA fits have also been obtained for both reactions but they are satisfactory only for the $^9Be(\tau,\alpha)^8Be$ reaction. (auth)

25101 FRAGMENTATION MECHANISM OF RELATIVISTIC HEAVY IONS. Lukyanov, V. K.; Titov, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett., B; 57: No. 1, 10-12(9 Jun 1975).

A model is proposed describing main features of a behavior of the fragmentation cross sections for relativistic ions including their relative yields. The reaction is assumed to proceed in two stages. At the first one the ion is excited by the peripheral

collision with a nucleus, at the second one it decays statistically in flight emitting a fragment. A strong analogy is demonstrated for the process with the corresponding reactions of nonrelativistic ions. (auth)

25102 OFF-SHELL πN EFFECTS IN PION–NUCLEUS INELASTIC SCATTERING. Garcilazo, H. (Instituto Politecnico Nacional, Mexico City. Escuela Superior de Fisica y Matematicas); Eisenberg, J. M. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Nucl. Phys., A; 244: No. 3, 487-496 (16 Jun 1975).

The inelastic scattering of pions in ^{12}C has been calculated and the effects of varying the form factors governing off-shell momentum dependence in the πN amplitudes have been examined. The distorted wave impulse approximation formalism was used and the calculation in momentum space was performed. (auth)

25103 ^{16}O INDUCED ONE-NUCLEON TRANSFER REACTIONS ON TARGETS OF ^{26}Mg, ^{27}Al, ^{30}Si AND ^{48}Ca. Ball, J. B.; Hansen, O.; Larsen, J. S.; Sinclair, D.; Videbaek, F. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., A; 244: No. 2, 341-364(9 Jun 1975).

Elastic scattering and one-nucleon transfer reactions induced by ^{16}O have been investigated in the energy region 45-60 MeV on targets of ^{26}Mg, ^{27}Al, ^{30}Si and ^{48}Ca. Angular distributions were measured in the angular range 4°-40°. Optical model parameters were derived from the elastic scattering data and the transfer reaction data were analyzed using both no-recoil and full-recoil DWBA codes. In the case of proton transfer reactions on ^{48}Ca, good agreement was obtained between the data and the DWBA calculations while the data for the lighter targets could not be satisfactorily reproduced. The oscillatory pattern of the angular distributions is discussed in terms of the three-parameter model of Kahana, and it is found that the model qualitatively explains the observed transition from smooth to oscillatory angular distributions. (auth)

25104 BEAM LOCALIZATION VIA ^{15}O ACTIVATION IN PROTON-RADIATION THERAPY. Bennett, G. W.; Goldberg, A. C.; Levine, G. S.; Guthy, J.; Balsamo, J. (Brookhaven National Lab., Upton, N. Y. (USA)); Archambeau, J. O. (Nassau County Medical Centre, East Meadow, New York, U. S. A.). Nucl. Instrum. Methods; 125: No. 3, 333-338(15 Apr 1975).

The importance of beam localization to heavy charged-particle radiation therapy is discussed. The results of the cross section for ^{15}O production by 200 MeV protons on ^{16}O are presented. Using published values for the cross section for this reaction at energies below 150 MeV the dose and event density to be expected from proton irradiation of a cylindrical tissue-equivalent phantom are calculated. Applications of this mechanism are discussed for beam localization, and mapping internal body structures of differing density and oxygen content. (auth)

25105 ANALYSIS OF ELECTRODISINTEGRATION OF NUCLEI USING E1 VIRTUAL RADIATION SPECTRA EVALUATED WITH COULOMB DISTORTED WAVES. Wolynec, E.; Moscati, G.; Goncalves, O. D.; Martins, M. N. (Sao Paulo Univ. (Brazil). Instituto de Fisica). Nucl. Phys., A; 244: No. 2, 205-212(9 Jun 1975).

Data on the ratio of photodisintegration to electrodisintegration of several nuclei (^{12}C, ^{63}Cu, ^{64}Zn, ^{109}Ag, ^{181}Ta and ^{197}Au) are compared with the theoretical ratios predicted by plane-wave and distorted-wave calculations. The analysis with distorted waves shows that all data are compatible with photoabsorption through dominant E1 transitions, as can be explained by the electric dipole sum rule. This outcome does not agree with published conclusions for high Z using the plane-wave approximation. (auth)

25106 MASS DISTRIBUTION OF FUSION PRODUCTS IN REACTIONS BETWEEN ^{19}F AND ^{12}C. Puehlhofer, F.; Pfeffer, W.; Kohlmeyer, B.; Schneider, W. F. W. (Marburg Univ. (F.R. Germany). Fachbereich Physik). Nucl. Phys., A; 244: No. 2, 329-340(9 Jun 1975).

Nuclear reactions between ^{19}F and ^{12}C target nuclei were studied at beam energies of 50, 63.2 and 76 MeV. Reaction products in the mass range from A = 11 to 31 emitted in forward direction (4°-20°) were identified with a time-of-flight telescope. Mass distributions of the fusion products were obtained. Their characteristic structure is interpreted as a consequence of the superposition of nucleon and α-particle emission. Qualitative conclusions are drawn on the relative intensities of the different decay modes of the compound nucleus. Fusion cross sections and estimates of the contribution of direct channels to the total reaction cross section are discussed. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 25098, 25103, and 25154.

25107 NUCLEAR SIZES OF $^{40,48}Ca$ AND $^{32,34}S$ ISOTOPES DETERMINED FROM 1 GeV PROTON ELASTIC SCATTERING. Alkhazov, G. D.; Belostotsky, S. L.; Domchenkov, O. A.; Dotsenko, Yu. V.; Kuropatkin, N. P.; Schuvaev, M. A.; Vorobyov, A. A. (Leningrad Institute of Nuclear Physics, Gatchina, USSR). Phys. Lett., B; 57: No. 1, 47-50(9 Jun 1975).

Differential cross sections for 1 GeV proton elastic scattering from $^{40,48}Ca$ and $^{32,34}S$ have been measured. The parameters of the nucleon distributions were obtained from an analysis of the experimental data. The difference between the neutron distributions in ^{40}Ca and ^{48}Ca is discussed in particular. (auth)

25108 ENERGY-DISPERSIVE METHOD FOR RESONANCE NEUTRON-CAPTURE GAMMA-RAY SPECTROSCOPY. Thomson, V. J.; Lopez, A. M.; Prestwich, W. V.; Kennett, T. J. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Physics). Nucl. Instrum. Methods; 126: No. 2, 263-268(1 Jun 1975).

A method for the determination of partial radiation cross sections based on the energy dispersion of the capture process is discussed. An experimental reactor facility, designed in order to perform these measurements, has been constructed. Experimental results for silicon are presented. (auth)

25109 MAGNETIC REORIENTATION. O'Brien, J. J.; Saladin, J. X. (Univ. of Pittsburgh). Phys. Rev., C; 8: No. 5, 1959-1960 (Nov 1973).

The effects of magnetic reorientation on the Coulomb excitation probability of the first 2^+ state of even-even nuclei are examined. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 25098, 25103, 25107, and 25142.

25110 (HEDL-TME-71-179, pp HEDL.17-HEDL.35) REACTION CROSS SECTIONS. McElroy, W. N.; Simons, R. L.; Kellogg, L. S. Dec 1971.

In LMFBR reaction rate and dosimetry. Quarterly progress report, September, October, November, 1971. (Hanford Engineering Development Lab., Richland, Wash. (USA)).

Re-evaluation of the $^{197}Au(n,\gamma)^{198}Au$ reaction cross section to provide integral consistency in relatively well known spectra resulted in better agreement with measured data than the old evaluation. However, this cross section follows the higher cross section measurements and is higher than other evaluations above 10^{-2} MeV. A preliminary evaluation of a $^{109}Ag(n,\gamma)^{110m}Ag$ reaction cross section, discussed here, will require readjustment to make it more consistent with integral results. The differences between measured and calculated reaction rates for exoergic reactions due to uncertainties in thresholds and subthresholds cross sections for reactions such as $^{54}Fe(n,p)^{54}Mn$ are discussed. (10 figures, 3 tables) (auth)

25111 γ-DECAY OF THE $g_{9/2}$ ANALOGUE STATE IN ^{59}Cu. Klapdor, H. V.; Schrader, M. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)); Bergdolt, G.; Bergdolt, A. M. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires). Nucl. Phys., A; 245: No. 1, 133-146(23 Jun 1975).

An investigation of the γ-decay of the $1g_{9/2}$ analogue state in ^{59}Cu has been performed using the $^{58}Ni(p,\gamma)^{59}Cu$ reaction. The (p,γ) excitation function has been taken in the range E_p = 3450-3650 keV. The decay schemes of the (p,γ) resonances at E_p = 3483, 3532 and 3547 keV, measured with Ge(Li) detectors, lead to eight new levels in ^{59}Cu with excitation energies between 1.8 and 4.7 MeV and to spin assignments of several states. The spins of the first two resonances are found to be $(1/2, 3/2)$ and $(5/2)$. The spin of the E_p = 3547 keV resonance is, from angular distributions, uniquely determined to be $J^\pi = 1/2^+$ and this state is found to be the unfragmented analogue state of the E^* = 3.062 MeV, $J^\pi = 1/2^+$ parent state in ^{59}Ni. The measured complete decay scheme of this resonance shows that its isovector M1 decay is in disagreement with all existing theoretical predictions. (auth)

25112 NUCLEAR SPECTROSCOPY AND STUDY OF PAIRING MODES NEAR N = 28 WITH THE (τ,n) REACTION. Bohne, W.;

Fuchs, H.; Grabisch, K.; Hilscher, D.; Jahnke, U.; Kluge, H.; Masterson, T. G.; Morgenstern, H. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kern- und Strahlenphysik). Nucl. Phys., A; 245: No. 1, 107-132 (23 Jun 1975).

Energy spectra and angular distributions of neutrons from the (τ,n) reaction on ^{48,50}Ti, ^{50,52}Cr, and ^{54}Fe at 13 MeV bombarding energy have been measured with the time-of-flight technique. Altogether 65 new levels in the final nuclei have been observed. The DWBA analysis of the angular distributions yielded 56 new J^π assignments, among them 26 levels with $J^\pi = 0^+$ and 27 levels with $J^\pi = 2^+$. The transitions to 0^+ states have been compared with predictions of the shell model and the pairing model. The purely harmonic pairing vibration model gives correct predictions near ^{56}Ni, but the agreement becomes worse with increasing distance from A = 56. The inclusion of anharmonicity effects, however, leads to a good overall description of all data (energies of ground and excited states, transitions strengths). (auth)

25113 POTASSIUM-48. Multhauf, L. G.; Tirsell, K. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.); Raman, S.; McGrory, J. B. (Oak Ridge National Lab., Tenn. (USA)). Phys. Lett., B; 57: No. 1, 44-46(9 Jun 1975).

The decay of ^{48}K has been studied for the first time. This activity was produced by means of the ^{48}Ca(n,p) reaction with 14 MeV neutrons. A group of five levels in ^{48}Ca near 7 MeV accounts for approx. 75% of the ^{48}K β-decay strength. (auth)

25114 SUB-PICOSECOND LIFETIMES FROM DOPPLER-SHIFT ATTENUATION MEASUREMENTS FOLLOWING (α,2p) AND (α,pn) REACTIONS ON ^{54}Fe IN SINGLES EXPERIMENTS. Urbon, J.; Sarantites, D. G.; Rutledge, L. L. Jr. (Washington Univ., St. Louis, Mo. (USA). Dept. of Chemistry). Nucl. Instrum. Methods; 126: No. 1, 49-55(15 May 1975).

A procedure is described by which the Doppler-shift attenuation technique is extended to measurement of nuclear-level lifetimes from singles experiments following two-nucleon emitting reactions. It is shown that in reactions such as (α,pn) and α,2p) it is possible to obtain sub-picosecond lifetimes from the careful measurement at several bombardment energies of the line shapes and centroid shifts of γ-rays near and above the threshold for the levels of interest. The values of (100 ± 15) fs, (580 ± 60) fs, and (180 ± 30) fs, (490 ± 50) fs were obtained for the mean lifetimes of levels at 3638.1, 4180.4 keV in ^{56}Co, and 3755.8, 5255.5 keV in ^{56}Fe, respectively. (auth)

25115 INELASTIC PROTON SCATTERING AND THE SPECTROSCOPY OF ^{54}Fe AND ^{56}Fe. Morrison, I.; Smith, R.; Amos, K. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Theoretische Kernphysik). Nucl. Phys., A; 244: No. 2, 189-204(9 Jun 1975).

The closure of the 28 neutron core in the nuclei ^{54}Fe and ^{56}Fe is investigated. The energy spectra, spectroscopic amplitudes and electromagnetic transition rates for the γ-decay of the low lying states in these nuclei were determined from a shell model calculation. Large neutron core breaking components in the wave functions of these low lying states result and these components contribute significantly both to the electromagnetic transition rates, and also in analyses of inelastic proton scattering from these nuclei. The inelastic scattering data were analyzed using an antisymmetrized distorted wave approximation that included core polarization corrections. The core polarization strengths required correlate to effective charges that are consistent with those required by the shell model calculations to match the experimental B(EL) values. (auth)

25116 HIGH-SPIN YRAST CASCADE IN ^{56}Co. Bendjaballah, N.; Delaunay, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire); Kim, H. J. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Phys., A; 244: No. 2, 322-328(9 Jun 1975).

Yrast levels of ^{56}Co were investigated via the study of in-beam γ-rays induced by the compound reaction ^{50}Cr(^{12}C,αpn)^{56}Co at 48 MeV (the maximum of the excitation function). The ordering and decay modes of the yrast levels were determined from analyses of the in-beam γ-ray angular distribution and γ-γ coincidence measurements. The yrast cascade is constituted by the ground state and the 0.577, 2.282 and 4.179 MeV levels. The spin assignments based on the present study are 5, 7 and 8 for the 0.577, 2.282 and 4.179 MeV levels respectively. The mixing ratios for the transitions between the yrast levels are also determined. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 25094, 25098, 25099, 25105, 25110, 25111, 25118, and 25154.

25117 (JINR-P3-8821) DETERMINATION OF THE SPIN CHANNEL CONTRIBUTIONS TO THE YTTRIUM P-RESONANCE. Nikolenko, V. G.; Samosvat, G. S. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 15p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Measurements of the angular dependence of the neutron scattering by ^{89}Y nuclei have been performed. Scattering areas have been determined for a number of strong resonances in the energy region up to approximately 25 keV. Conclusions have been drawn on spins of some p-resonances on the basis of the changes of areas with scattering angle. For p-resonances with spin 1 there were obtained the contributions of the channel spin components of neutron widths. (2 figures, 1 table) (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 25094, 25098, 25109, 25110, and 25142.

25118 (JINR-P4-8743) COLLECTIVE MODELS AND MICROSCOPIC APPROACH TO DESCRIPTION OF PROPERTIES OF SPHERICAL AND TRANSITION NUCLEI. Dzholos, R. V.; Yanssen, D. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

Data on energy levels, E2 transition probabilities, and quadrupole moments of collective states of spherical and transition nuclei are analyzed. It is pointed out which measurements have to be performed for a more complete check of theoretical approaches. (5 figures, 3 tables) (auth)

25119 (JINR-P6-9005) l-FORBIDDEN M1 TRANSITIONS OF THE $1g_{\frac{9}{2}} \rightleftharpoons 2d_{\frac{5}{2}}$ AND $2d_{\frac{5}{2}} \rightleftharpoons 3s_{\frac{1}{2}}$. Marupov, N. Z.; Morozov, V. A.; Muminov, T. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 14p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The lifetimes of the nuclear excited states which decay through the l-forbidden M1 transitions $1g_{\frac{9}{2}} \rightleftharpoons 2d_{\frac{5}{2}}$ and $2d_{\frac{5}{2}} \rightleftharpoons 3s_{\frac{1}{2}}$ are compiled. The reduced transition probabilities and single-particle hindrance factors for M1 transitions and their E2 components are calculated. (1 figure, 4 tables) (auth)

25120 (JINR-P7-8676) SYSTEMATICS OF THE ROTATIONAL BAND INTENSITIES AND FEEDING TIMES IN HEAVY-ION COMPOUND-NUCLEUS REACTIONS. Bochev, B.; Karamyan, S. A.; Kutsarova, T.; Oganesyan, Yu. Ts. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 31p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

Experimental data on intensities and feeding times of the rotational bands of even–even nuclei produced in the (HI, xn) reactions were classified. The correlation between the average spin of the populated level and the average angular momentum of the compound nucleus was considered quantitatively. Semiquantitative calculations are given for angular momentum and excitation energy distributions of the nuclei after the neutron evaporation for a fixed final product of the reaction. A simple formula has been given for calculation of l_{crit} —a critical angular momentum for production of a compound nucleus in the interaction of heavy ions with nuclei. (6 figures, 2 tables) (auth)

25121 (ORO-3924-19) ANGULAR MOMENTUM EFFECTS IN NUCLEAR REACTIONS. Progress Report, 1 January 1975–31 July 1975. Natowitz, J. B. (Texas Agricultural and Mechanical Univ., College Station (USA). Cyclotron Inst.). 1975. Contract AT(40-1)-3924. 31p. Dep. NTIS $4.75.

A summary is presented for research performed under ERDA Contract No. AT-(40-1)-3924 during the period 1 January 1975 to 31 July 1975. Fission and fission-like reactions of 107- to 197-MeV ^{12}C projectiles with medium-mass targets have been studied. The elemental yields, energy spectra, and angular distributions of fission-like products are interpreted in terms of the concept of critical asymmetry and related to the maximum angular momentum for fusion. Total kinetic energies for the fission of medium-mass elements are reported. The angular momentum dependence of the kinetic energy for symmetric division is found to be less than 0.7 keV/$\hbar^2$. The possibility of a lower limit to

the angular momentum of fusion is discussed. Gas ionization detectors have been constructed and tested for in-beam fusion and fission studies. Preliminary experiments to measure the γ-ray continuum in coincidence with heavy fusion recoils from the reactions of ^{12}C with ^{27}Al are reported. The first results of a collaborative study of fragment emission in reactions induced by 800-MeV protons are summarized. (auth)

For a title listing of a selected paper see: 25122.

25122 (ORO-3924-19, pp 2, 3-5) COINCIDENCE STUDIES OF FISSION AND FISSION-LIKE REACTIONS. Namboodiri, M. N.; Geoffroy, K.; Natowitz, J. B. 1975.

In angular momentum effects in nuclear reactions. Progress Report, 1 January 1975–31 July 1975. (Texas Agricultural and Mechanical Univ., College Station (USA). Cyclotron Inst.).

25123 LEVEL POPULATION IN $^{108,110}Pd$ IN THE INELASTIC SCATTERING OF REACTOR FAST NEUTRONS. Govor, L. I.; Demidov, A. M.; Shukalov, I. B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii); Ahmed, M. R.; Shakarchi, Kh. I.; Al-Najjar, S.; Al-Amili, M. A.; Al-Assafi, N. (Iraq Atomic Energy Commission, Baghdad. Nuclear Research Inst.). Nucl. Phys., A; 245: No. 1, 13-28(23 Jun 1975).

Spectra of γ-rays from the inelastic scattering of reactor fast neutrons on $^{108,110}Pd$ are measured. 131 and 126 γ-lines were observed in the spectra of ^{108}Pd and ^{110}Pd, respectively. Gamma-transition schemes are constructed for these nuclei. New levels are introduced and J^π values for some of the levels are determined. Comparison is made between the level populations from the reaction and those theoretically predicted with a statistical model. A strong phonon forbiddenness in the decay of the 3^+ state in $^{104,106,108,110}Pd$ is revealed. (auth)

25124 GAMMA DECAY AFTER HEAVY ION REACTIONS STUDIED BY FIRST AND HIGHER ORDER MULTIPLICITY MEASUREMENTS. Hagemann, G. B.; Broda, R.; Herskind, B.; Ishihara, M.; Ogaza, S. (Niels Bohr Institutet, Copenhagen (Denmark)); Ryde, H. (Roskilde University Center, Roskilde, Denmark). Nucl. Phys., A; 245: No. 1, 166-188(23 Jun 1975).

First and higher order multiple coincidence rates have been measured for the γ-rays from ^{16}O induced reactions on targets of $^{148,150}Nd$ at various bombarding energies. Average values and shape parameters for the γ-ray multiplicity distributions have been extracted from the data. The multiplicities are connected to angular momentum through complete fusion cross sections, and conclusions are drawn on spin distributions of entry states in the final nuclei as well as on the decay pattern from these states. (auth)

25125 ONE- AND TWO-STEP PROCESSES IN (p,t) TRANSITIONS TO THE QUADRUPOLE AND OCTUPOLE-VIBRATIONAL STATES IN $^{122,128}Te$. Izumoto, T. (Tokyo Univ. (Japan)); Aoki, Y.; Rangacharyulu, C.; Yagi, K. (Osaka Univ. (Japan)); Matoba, M.; Hyakutake, M. (Kyushu Univ., Fukuoka (Japan)). Phys. Lett., B; 57: No. 1, 17-20(9 Jun 1975).

A second-order DWBA analysis is performed for the $^{124,130}Te$ (p,t)$^{122,128}Te$ reactions at E_p = 51.9 MeV. It is found that the (p,t) excitations of one-phonon 2_1^+ and 3_1^- states in ^{122}Te receive large contributions from inelastic two-step processes, while those of ^{128}Te receive dominant contributions from one-step processes. (auth)

25126 UNEXPLAINED MINIMUM IN PRESSURE DEPENDENT PAC's. Berek, U.; Kreisel, W.; Schneider, H.; Tierno, E. (Giessen Univ. (F.R. Germany). Strahlenzentrum). Phys. Lett., A; 53: No. 3, 251-253(16 Jun 1975).

None of the present PAC theories can satisfactorily explain the pressure-dependence of EC-induced PAC's over the full pressure range. The purpose of this letter is twofold: first, to make available the experimental A_2G_2, A_4G_4 coefficients of the PAC for two typical cascades in ^{127}I, from 1 torr up to 78 atm and, secondly, to give a concise discussion of the theoretical problems which remain to be solved. (auth)

25127 MICROSCOPIC OPTICAL MODEL ANALYSIS OF ^3He SCATTERING FOR SAMARIUM ISOTOPES. Eagle, R.; Griffiths, R. J.; Sinha, B. C. (King's Coll., London (UK). Wheatstone Physics Lab.). Phys. Lett., B; 57: No. 1, 31-34(9 Jun 1975).

Microscopic models have been used to fit the ^3He elastic scattering cross sections for the samarium isotopes at 53 MeV. A double folding model using an effective nucleon-nucleon interaction works reasonably well. A microscopic model using the Feshbach formalism to extend the nucleon-nucleus optical potential to composite particles produces too diffuse a potential. The variation of volume integrals per particle pair and root mean square radii over an isotopic sequence are discussed for the three models. (auth)

25128 PROPERTIES OF ^{105}Pd IN THE ACTIVATED STATE. Begzhanov, R. B.; Gladyshev, D. A.; Muminov, A. I.; Yuldashev, U. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 44-47(1975). (In Russian).

Some quantum characteristics of the excited states of ^{105}Pd were studied by methods of perturbed and unperturbed angular correlations. The results are compared with those predicted from modern nuclear models. (1 table) (tr-auth)

25129 NEUTRON TOTAL AND SCATTERING CROSS SECTIONS OF SOME EVEN Mo ISOTOPES AND THE OPTICAL MODEL. Smith, A. B.; Guenther, P.; Whalen, J. (Argonne National Lab., Ill. (USA)). Nucl. Phys., A; 244: No. 2, 213-235 (9 Jun 1975).

Neutron total cross sections of ^{92}Mo, ^{96}Mo, ^{98}Mo and ^{100}Mo were measured at intervals of about 10 keV from 1.6 to 5.5 MeV with resolutions of approximately 10 keV. Neutron elastic and inelastic scattering cross sections of these isotopes were measured from 1.8 to 4.0 MeV at intervals of 0.2 MeV. Neutron groups corresponding to the excitation of forty states were identified. The experimental results were examined in the context of optical and statistical nuclear models. It was concluded that the real part of the optical potential includes a term proportional to (N-Z)/A and suggested that the imaginary part of the potential was shell dependent with decreasing magnitude as N = 50 is approached. Comparison of measured and calculated inelastic neutron excitation cross sections suggested a number of J^π assignments extending previous knowledge. (auth)

25130 HIGH SPIN STATES IN ^{93}Mo POPULATED IN THE (p,n) REACTION. Guenther, C.; Banaschik, M. V.; Huebel, H.; Schneider, W. D.; Gonsior, K. H.; Herzog, P. (Bonn Univ. (F. R. Germany). Inst. fuer Strahlen- und Kernphysik). Nucl. Phys., A; 244: No. 2, 287-300(9 Jun 1975).

High spin states in the $\nu 25/2(\pi g9/2)^2$ multiplet in ^{93}Mo were investigated with the $^{93}Nb(p,n)^{93}Mo$ reaction. A new isomeric state at 2430 keV with a lifetime of 3.53 ± 0.18 ns is interpreted as the lower $17/2^+$ of the multiplet. A number of further states have been identified. The results are compared to previous experiments and shell-model calculations. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 25094, 25105, 25109, 25119, and 25124.

25131 (UH-511-162-73, pp 90-95) INCLUSIVE PRODUCTION OF HIGH TRANSVERSE MOMENTUM SECONDARIES AT 200 AND 300 GeV. Frisch, H. (Univ. of Chicago). Sep 1973).

From fifth topical conference in particle physics; Honolulu, Hawaii, USA (8 Aug 1973).

In fifth Hawaii topical conference in particle physics. (Hawaii Univ., Honolulu (USA)).

The invariant cross sections are shown for the inclusive production of positive pions from a tungsten target at 200 and 300 GeV. A strong energy dependence is indicated clearly. It is also found that the particle ratios p/π^+, anti p/π^-, and K^-/π^- ratios tend to rise to a peak at a p of 2 to 3 GeV and then fall. The K^+/π^+ rises but does not fall as sharply. (JFP)

25132 ENERGIES AND INTENSITIES OF γ-RAYS FOLLOWING THE DECAY OF ^{165}Dy. Ardisson, G. (Institut d'Etudes Nucleaires, Algiers (Algeria)). Nucl. Instrum. Methods; 126: No. 2, 269-271(1 Jun 1975). (In French).

Energies and intensities of γ rays following the β decay of 2.3 h ^{165}Dy were remeasured using coaxial Ge(Li) detectors. A series of mean values was obtained by weighting these results with data of other authors in order to constitute an available set for calibration of Ge(Li) detectors. (auth)

25133 LIFETIMES OF 2^+ AND 4^+ STATES IN ^{168}Er. Awwad, Z.; Abdel-Hallem, A.; El-Aasser, M. R. (Atomic Energy Establishment, Cairo). Acta Phys. Acad. Sci. Hung.; 37: No. 1-2, 141-150(1974).

The lifetimes of the 2^+ and 4^+ states of $^{168}_{68}Er$ nucleus have been determined by means of the delayed coincidence method, using a magnetic double lens coincidence spectrometer and a start-stop time-to-pulse height converter coupled to a fast-slow coincidence system. The experimental ratios of $B(E\ 2,4^+ \rightarrow 2^+)/$

B(E $2,2^+ \rightarrow 0^+$) and some of the nuclear parameters are deduced and discussed. (5 figures, 2 tables) (auth)

25134 QUASI-PROLATE AND QUASI-OBLATE BANDS IN SOFT ^{189}Au. Berg, V.; Foucher, R. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire); Hoeglund, Aa. (Stockholm Univ. (Sweden). Fysiska Institutionen). Nucl. Phys., A; 244: No. 3, 462-486(16 Jun 1975).

The decay of ^{189}Hg is studied using mass separated sources. Internal conversion coefficients are determined for 57 transitions and the half-lives of four excited states in ^{189}Au are measured. A decay scheme with 55 states is proposed. It is found that ^{189}Au has many features in common with the heavier gold isotopes. However ~⅓ of the total ^{189}Hg decay proceeds via a new system of negative parity states to the $11/2^-$ isomer. The new states are suggested as resulting from the Coriolis decoupling of a proton in the $h_{9/2}$ orbital. This interpretation implies that a tendency for oblate as well as prolate shapes exists in ^{189}Au. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 25094, 25099, 25105, 25119, and 25142.

25135 (JINR-P3-9047) ENERGY DEPENDENCE OF THE INTERACTION CROSS SECTION OF NEUTRONS WITH ^{207}Pb NUCLEUS IN THE ENERGY RANGE FROM 16 TO 18 MeV. Benetskii, B. A.; Klyachko, A. V.; Nefedov, V. V.; Frank, I. M.; Shtranikh, I. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The measurements of the interaction cross section of neutrons with ^{207}Pb nucleus being earlier performed in the neutron energy range from 13.3 to 17.1 MeV then were extended to the energies up to 18.5 MeV. The obtained results confirmed qualitatively the existence of the resonance character peculiarity at 16.8 MeV. The cross section deviation from the mean value is about 1÷2%, i.e., it is apparantly smaller than that previously mentioned and is not of a symmetric maximum form. (3 figures) (auth)

25136 EXTENSION OF RELATIVE α-DECAY RATE THEORY TO SPHERICAL DOUBLY ODD NUCLEI (^{210}At). Shihab-Eldin, A. A.; Jardine, L. J.; Rasmussen, J. O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., A; 244: No. 3, 435-448(16 Jun 1975).

The one-level R-matrix alpha-decay rate theory has been extended to the alpha-decay of doubly odd nuclei by carrying out the more involved recoupling and fractional parentage expansion. Graphical representations are employed to carry out the expansion which greatly simplifies the calculations. Relative alpha-decay rates of ^{210}At were calculated assuming shell-model wave functions of the pure configurations $[\pi(h_{9/2})\nu(f_{5/2})^{-1}\nu(p_{1/2})^{-2}]$ and $[\pi(h_{9/2})\nu(f_{5/2})^{-2}\nu(p_{1/2})^{-1}]$ for the low-lying states in ^{206}Bi that are fed in the decay. The overall agreement with experiment is good except for decay to the 4_1^+, 5_1^+ and 5_2^+ states. It is shown that agreement for these states can be greatly improved if mixtures from the two pure configurations assumed above are admixed with the higher $[\pi(h_{9/2})\nu(p_{3/2})^{-1}\nu(p_{1/2})^{-2}]$ configuration in the description of the 4_1^+, 5_1^+ and 5_2^+ wave functions. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 25090, 25094, 25098, and 25110.

25137 (UCID-16878) PREVIEW OF A MEASUREMENT OF THE NEUTRON-INDUCED FISSION CROSS SECTION OF ^{241}Pu RELATIVE TO ^{235}U FROM 0.1 TO 30 MeV. Behrens, J. W.; Carlson, G. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Aug 1975. Contract W-7405-Eng-48. 5p. Dep. NTIS $4.00.

The ratio of the ^{241}Pu to ^{235}U neutron-induced fission cross sections was measured with fission ionization chambers at the LLL 100-MeV electron linear accelerator. The time-of-flight technique was used to measure the cross section ratio as a function of neutron energy from 0.001 to 30 MeV. The continuous energy spectrum of the neutron source allowed us to cover the entire energy range in one measurement. Pulse height distributions were also measured as functions of neutron energy over broad energy bands. Based on these measurements, the energy variations in the efficiency were estimated to be less than 0.75 percent. The threshold cross section method was used to normalize the ratio in the MeV energy range, independent of other cross section measurements. The ratio was also taken to thermal neutron energy where it was normalized to evaluated thermal fission cross section ratios. Good agreement was found when the two means of normalization were compared. Typical energy resolution is 5 percent at 20.0, 1.0, and 0.1 MeV. Most of the data have counting uncertainties smaller than 4 percent. Systematic errors are discussed, and current results are compared with previous measurements. Tables of data are included. (1 figure) (auth)

25138 M SHELL IONIZATION IN α DECAY. Scott, R. D. (SEE CODE- 5681300 Scottish Research Reactor Centre, East Kilbride (UK)). Phys. Lett., B; 57: No. 1, 35-38(9 Jun 1975).

The results of a simple calculation of the M shell ionization probably in α decay are presented. The sudden approximation has been used with non-relativistic hydrogen-like wave functions and an attempt is made to estimate the likely result of such a calculation using relativistic self-consistent field wave functions. The predicted M X-ray yield is about half of the experimental value and is close to the recent theoretical result of Hansen. (auth)

Nuclear Theory

Refer also to abstracts 25017, 25051, 25074, and 25101.

25139 (JINR-P4-8778) PROBLEM OF 0+ STATE STRUCTURE IN EVEN-EVEN SPHERICAL NUCLEI. Dambasuren, D.; Vdovin, A. I.; Stoyanov, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 19p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The effect of interaction of pair vibrations with two-phonon multipole states on the spherical nucleus 0^+ level properties has been studied in the framwork of a superfluid nucleus model. The expressions are obtained for the level energies as well as the wave function structure. The two-nucleon transfer reactions to excited 0^+ states have been studied. (auth)

25140 (JINR-P4-8853) LEVEL: A PROGRAM FOR CALCULATION OF EXCITED STATE DENSITY IN ATOMIC NUCLEI. Zheregi, F. G.; Il'inov, A. S.; Toneev, V. V.; Shubin, Yu. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 31p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

General relations of the level density theory are listed, and a program for calculation of the thermodynamic nuclear characteristics of a given one-particle spectrum was described. The program can be used in the studies of the statistical properties of reactions at both low and high energies and, in particular, in the analysis of the dependence of the shell effects in the level density on the excitation energy of nuclear system. (auth)

25141 (JINR-P4-8988) EFFECTIVE CROSS SECTION FLUCTUATIONS IN UNITARY THEORY. Lyuboshits, V. L.; Podgoretskii, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

In the framework of a single-channel theory of overlapping resonances, satisfying the unitarity condition, the fluctuations of the effective cross sections and the structure of the correlation coefficients for the amplitudes and cross sections were studied. It is shown that at a high overlapping of the resonance levels the characteristic correlation period is determined by an average distance between the levels Δ, but not by the width. The obtained results differ from the conclusions of the statistical Erikson theory. (auth)

25142 (COO-3001-81) VALIDITY OF THE FACTORIZATION HYPOTHESIS FOR NUCLEUS-NUCLEUS CROSS SECTIONS AT HIGH ENERGIES. Barshay, S.; Dover, C. B.; Vary, J. P. (State Univ. of New York, Stony Brook (USA); Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. Contract AT(11-1)-3001. 10p. Dep. NTIS $4.00.

Nucleus-nucleus cross sections for a variety of projectile and target nuclei and a wide range of energies have been calculated. Total, reaction and elastic cross sections, as well as the slopes of the elastic diffraction peak, exhibit an approximate factorization property when the nuclei differ by less than 50 percent in r.m.s. radii. A simple geometrical interpretation is provided for the failure of factorization which occurs when target and projectile differ greatly in size. (1 figure, 1 table) (auth)

25143 ELASTIC TRANSFER PROCESSES IN HEAVY ION SCATTERING. Von Oertzen, W. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kern- und Strahlenphysik); Bohlen, H. G. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Phys. Rep.; 19: No. 1, 1-61(Jun 1975).

A survey of the scattering of nuclei on nuclei of adjacent masses in which elastic transfer can occur is given. Scattering systems with mass differences ranging from 1 nucleon up to 5 nucleons are discussed. The interpretation of the available data in terms of the (i) optical model, (ii) the coherent addition of elastic scattering and transfer using the DWBA and (iii) in terms of the molecular two state approximation and coupled channels are discussed. Examples of calculations are given and the extraction of spectroscopic information is illustrated. The occurrence of multiple exchange of nucleons—higher order effects compared to DWBA—is discussed. It is shown that these effects are possible for weakly absorbing scattering systems. Future applications and extensions to larger masses are outlined. (auth)

25144 SELF-CONSISTENT SINGLE PARTICLE MODEL IN NUCLEAR PHYSICS. Mang, H. J. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). Phys. Rep.; 18: No. 6, 325-368(Jun 1975).

The nuclear many body problem is treated in the single-particle approximation, i.e., on the basis of the Hartree-Fock-Bogolyubov approximation. Results of various applications are presented and discussed with emphasis on properties of rotational states of deformed nuclei. (auth)

25145 ESTIMATE OF THE INTERNAL EXCITATION ENERGY IN FISSION. Schultheis, H.; Schultheis, R. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 57: No. 1, 7-9(9 Jun 1975).

A comparison of the potential energy at scission with experimental post-scission data yields an estimate of 7 MeV and an upper bound of 25 MeV for the internal excitation energy at scission. Complete damping during the descent to scission can be ruled out. (auth)

25146 VERTEX-FUNCTION APPROXIMATION IN THE AHK ALGORITHM FOR THE EFFECTIVE INTERACTION. Anastasio, M. R.; Kuo, T.T.S. (Oslo Univ. (Norway). Fysisk Institutt); McGrory, J. B. (Phys. Lett., B; 57: No. 1, 1-6(9 Jun 1975). (9 Jun 1975).

The convergence properties of the AHK algorithm for determining the energy-independent effective interaction are investigated. The lower-order perturbation approximations and the Padé approximant to the Q-box vertex function yield encouraging results for the states with large P-space overlaps. (auth)

25147 ELEMENTARY EXCITATIONS IN VIBRATIONAL NUCLEI. Arima, A. (Tokyo Univ. (Japan). Dept. of Physics); Iachello, F. (Rijksuniversiteit Groningen (Netherlands). Kernphysisch Versnneller Instituut). Phys. Lett., B; 57: No. 1, 39-43(9 Jun 1975).

It is proposed to describe the entire collective spectrum of vibrational nuclei in terms of few interacting elementary excitation modes. The case in which only two elementary modes are important (the quadrupole d and the octupole f-bosons) is discussed in detail. Explicit expressions for the energy levels and transition matrix elements are given. (auth)

25148 SIMPLE MICROSCOPIC FOUNDATION OF THE BREATHING MODE. Sotona, M; Zofka, J. (Ustav Jaderne Fyziky, Rez (Czechoslovakia)). Phys. Lett., B; 57: No. 1, 27-30(9 Jun 1975).

It is put forward that the method of hyperspherical harmonics with its collective hyperradius represents a natural microscopic description of the breathing mode—typically collective state. A connection with the hydrodynamical model and its limitation are illustrated and some applications are suggested. (auth)

25149 THREE-BODY FORCES AND SHELL-MODEL BINDING ENERGIES. Cole, B. J.; Watt, A.; Whitehead, R. R. (Glasgow Univ. (UK). Dept. of Natural Philosophy). Phys. Lett., B; 57: No. 1, 24-26(9 Jun 1975).

Shell-model binding energy data in the sd shell are found to be consistent with a small 3-body force in addition to the usual 1- and 2-body forces. Some credence is given to the analysis by the similarity of the 3-body terms in the binding energies produced by the Kuo and Preedom-Wildenthal interactions and by the expected appearance of very different 2-body terms. (auth)

25150 ANISOTROPIC SURFACE TENSION AND THE LIQUID DROP MODEL. Mackie, F. D. (Illinois Univ., Urbana (USA). Dept. of Physics). Nucl. Phys., A; 245: No. 1, 61-86(23 Jun 1975).

The liquid drop model assumes that the surface tension of all nuclei is isotropic. The consequences of relaxing this assumption are studied. First a macroscopic theory of anisotropic surface tension is presented. Then with a particular choice for the functional form of the surface tension tensor, this theory is applied to a charged liquid drop. A small anisotropy in the surface tension can significantly distort a highly charged drop and lower its fission barrier. (auth)

25151 INVESTIGATION OF THE SCALED MODIFIED OSCILLATOR POTENTIAL. Bengtsson, R. (Tekniska Hoegskolan, Lund (Sweden). Institutionen foer Matematisk Fysik). Nucl. Phys., A; 245: No. 1, 39-60(23 Jun 1975).

In the second volume of their book Nuclear Structure, Bohr and Mottelson propose that in the modified oscillator potential the spin-orbit term and the l^2 term should be scaled according to the deformation of the potential. This scaling has been studied in detail, and some of its more general consequences are discussed. The single-particle parameters κ and μ have been fitted for nuclei in the rare earth region, for lead and for actinides. The scaled potential has been used for a detailed investigation of the nuclei in the actinide region, including calculations of potential energy surfaces, fission barriers and ground-state masses. Both symmetric and reflection asymmetric deformations have been considered and the results thus obtained with the scaled potential have been compared to those obtained with the modified oscillator potential and the folded-Yukawa potential. (auth)

25152 SPIN AND ISOSPIN DEPENDENCE OF THE IMAGINARY PART OF THE NUCLEAR OPTICAL MODEL POTENTIAL. Haensel, P. (Warsaw Univ. (Poland). Instytut Fizyki Teoretycznej). Nucl. Phys., A; 245: No. 1, 29-38(23 Jun 1975).

The spin and isospin dependent terms of the imaginary part of the medium and high energy nuclear optical model potential for infinite nuclear matter are calculated using the approximation which includes some of the exclusion principle and dispersion effects of the medium. Numerical results are obtained with the Livermore phase parameters and applied to finite nuclei using the local density approximation. (auth)

25153 STUDY ON THE ROTATION-PARTICLE COUPLING. Hara, K.; Kusuno, S. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). Nucl. Phys., A; 245: No. 1, 147-165(23 Jun 1975).

It is shown that the standard Coriolis coupling is subject to modification due to the residual two-body interaction. The attenuation factor is explicitly derived. The basic point is that, in deformed odd nuclei, the last particle couples not only to the vibrational modes of the doubly even core but also to the spurious (rotational) mode. The effect of the latter amounts to the correction to the Coriolis force of the rotating system. The corresponding effect in the case of the translational motion makes the translation-particle coupling vanish. The system thus recovers the translational and the Galilean invariance. (auth)

25154 THEORY OF ROTATIONAL STATES OF ODD–ODD ATOMIC NUCLEI. Israilov, A. A.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 51-55(1975). (In Russian).

On the basis of a model of an even–even core plus valence nucleons with definite values of total angular momenta, the spectrum for single-particle rotational states of odd–odd atomic nuclei is calculated. Rotational motion is described by a Hamiltonian with variable moments of inertia. The results of theoretical calculations are compared with experimental data for the nuclei ^{30}P and ^{60}Cu. (2 figures, 1 table) (tr-auth)

25155 USE OF THE OSCILLATOR APPROXIMATION IN NUCLEAR PHYSICS. Fai, G. (Roland Eotvos Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 37: No. 1-2, 151-159(1974).

Hartree–Fock single particle wave functions of spherical nuclei are approximated by harmonic oscillator wave functions. The best fitting value of the oscillator parameter is calculated for each single particle state. The systematics of the oscillator parameters is studied. The validity of the harmonic oscillator model is examined. (3 tables) (auth)

25156 FEW-NUCLEON SU(3) PARENTAGE COEFFICIENTS AND α-PARTICLE SPECTROSCOPIC AMPLITUDES FOR CORE EXCITED STATES IN S-D SHELL NUCLEI. Hecht, K. T.; Braunschweig, D. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). Nucl. Phys., A; 244: No. 3, 365-434(16 Jun 1975).

The SU(6)/SU(3) factors of few-nucleon fractional parentage coefficients in ls-Od shell nuclei are calculated directly without being generated recursively from one-nucleon c.f.p. Tabulations

are given for x-nucleon reduced matrix elements, (x = 4, 3, 2, 1), connecting states of high SU(3) symmetry, where the x-nucleon states are limited to states of totally symmetric space and oscillator quanta symmetry, i.e. SU(3) representations (80), (60), (40), (20) for states of space symmetries [4], [3], [2], [1]. Together with the SU(3)/R(3) factors calculated by Draayer, these reduced matrix elements make it possible to predict spectroscopic amplitudes for reactions in which the x-nucleon groups are transferred in unexcited (Os) internal states. In a specific application, α-particle spectroscopic amplitudes are calculated for core-excited states in s-d shell nuclei, reached by the transfer of $(Op)^{-}$ $(1sOd)^{-3}$, or $(Op)^{-2}$ $(1sOd)^{-2}$ groups in pickup reactions and $(1sOd)^{3}$ $(1pOf)^{1}$ or $(1sOd^{2}(1pOf)^{2}$ groups in stripping reactions, where states in the final residual nuclei are approximated by SU(3) strong coupling states, (free of spurious c.m. excitation), corresponding to the largest possible intrinsic deformations in these nuclei. The effect of a difference in α-particle size parameters in projectile and residual nuclei is discussed. (auth)

25157 STUDY OF THE NUCLEAR RESPONSE FUNCTION. Bertsch, G. F.; Tsai, S. F. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Phys. Rep.; 18: No. 2, 125-158(May 1975).

The excitation properties of spherical nuclei are examined in the the Random Phase Approximation using the Green's function method. The calculations are done with interactions of the Skyrme type for nuclei from ^{16}O to ^{208}Pb. Different Skyrme interactions can have the same predictions for ground state Hartree-Fock properties, but give quite different predictions for the dynamic response. The calculations favor a mild velocity-dependence in the interaction, such as given by Skyrme I. The level of agreement with empirical properties is as follows: energies of low-lying states, ~25%; positions of giant resonances, ~10%; transition rates of low states, factor of 2 typical. Inelastic scattering of electrons is reasonably accounted for by the model, but nucleon inelastic scattering has difficulties with the noncollective strength. (auth)

25158 BRUECKNER THEORY OF NUCLEI. Koehler, H. S. (Arizona Univ., Tucson (USA). Dept. of Physics). Phys. Rep.; 18: No. 4, 217-261(May 1975).

124 refs.

This paper reviews developments of the Brueckner theory of nuclei, starting with the multiple-scattering approach in the 1954 papers of Brueckner et al. Inevitably, the presentation represents the authors personal view on the problems. Theories rather than calculations have been emphasized. The latter depend very much upon the two-nucleon interaction which is still not known in sufficient detail. The definition of the Brueckner reaction-matrix is discussed at some length with regard to insertions in hole- and particle lines. Lowdin's Exact Self-Consistent-Field theory that provides an exact many-body reaction matrix is given a short presentation for comparison with Brueckner's theory as applied to finite nuclei. Considerable attention has been given to the shell model potential required for calculations on finite nuclei. The concept of single-particle energies is discussed in some detail in relation to removal energies. Some numerical results are reviewed either for illustrating the theory or because they are recent. (auth)

25159 EFFECTIVE HAMILTONIAN AND SPECTRA OF THE Op SHELL. Dirim, H.; Elliott, J. P.; Evans, J. A. (Sussex Univ., Brighton (UK). School of Mathematical and Physical Sciences). Nucl. Phys., A; 244: No. 2, 301-314(9 Jun 1975).

The effective Hamiltonian for the 0p shell has been calculated up to second order using modified Sussex matrix elements. The resulting spectra and binding energies are compared with experiment and the role of the effective three-body interaction is discussed. (auth)

25160 ANALYSIS OF REACTIONS WITH POLARIZED DEUTERONS. II. Seiler, F. (Basel Univ. (Switzerland). Physikalisches Inst.). Nucl. Phys., A; 244: No. 2, 236-286(9 Jun 1975).

Criteria for a simplified analysis of polarization measurements on reactions of deuterons with light nuclei are derived. In these reactions prominent resonances appear at deuteron energies up to several MeV. The characteristic signature of such levels in polarization data can be used to determine the spin parameters of the resonant element. Methods developed in an earlier paper, dealing with isolated resonances, are supplemented to include interference terms between two or more (l,s,J) reaction matrix elements. Linear relations between expansion coefficients of different polarization quantities are given for various cases. The application of these criteria in a simple, preliminary analysis is discussed and demonstrated using experimental data available at present. (auth)

25161 POLARIZATION EFFECTS IN (P(POL),π^{+}) REACTIONS. Noble, J. V. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Nucl. Phys., A; 244: No. 3, 526-532(17 Jun 1975).

The pionic stripping model of $(\vec{p},\pi^{+})$ is used to derive predictions of polarization effects, including (polarized proton) + (unpolarized everything else) right-left asymmetries, stripping to partially filled shells, and selected (polarized beam) + (polarized target) experiments. (auth)

25162 APPROXIMATION METHODS FOR LOW-ENERGY POTENTIAL SCATTERING. Garibotti, C. R.; Mignaco, J. A. (Departamento de Fisica, Facultad de Ciencias Exactas e Ingenieria, Universidad Nacional de Rosario, Argentina). Nucl. Phys., A; 244: No. 3, 449-461(16 Jun 1975).

A systematic method is developed for short-range central potentials, to obtain the coefficients of the momentum expansion of wave function and scattering amplitude for any value of the angular momentum. The corresponding effective range solution and Padé approximants for the κ-variable expansion of the S-matrix are studied. Both methods are compared as a means to find the analytical behaviour of the scattering function in the complex momentum plane. As an example, numerical calculations have been performed for the S-wave amplitude of a spherical square-well potential. Results show an outstanding ability of diagonal Padé approximants to reproduce in a fastly convergent way the trajectories of the poles in the κ-plane. (auth)

PHYSICS (RADIATION AND SHIELDING)

25163 INTENSITY MEASUREMENTS AND SHIELDING OF A FAST-NEUTRON BEAM FOR BIOLOGICAL AND MEDICAL APPLICATION. Meulders, J. P.; Leleux, P.; Macq, P. C.; Pirart, C.; Valenduc, G. (Louvain Univ. (Belgium)). Nucl. Instrum. Methods; 126: No. 1, 81-85(15 May 1975).

The (d,n) reaction, on thick (^{9}Be, ^{12}C, nat Cu, nat Mo, ^{181}Ta, ^{197}Au) and thin (^{9}Be) targets, has been performed at E_d = 16, 33, 50 MeV; neutron spectra, angular distributions, and doses are compared with estimations. The 50 MeV neutron beam from the ^{9}Be(d,n) reaction has been used to study the neutron transmission through some shielding materials, i.e. steel, lead, lucite, borated paraffine, and concrete. (auth)

Radiation Physics

Refer also to abstracts 24450, 24896, and 25104.

25164 (AEC-tr-7314, pp 1-8) APPLICATION OF MONTE CARLO METHOD IN THE CALCULATION OF THE PASSAGE OF CHARGED PARTICLES THROUGH MATTER. Mingaleev, G. S.; Trent'ev, B. M. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

A description of the various physical methods in the calculation scheme of the Monte Carlo method is given, along with some of the important results in the new field of radiation technology, namely in the creation of radiation units based on β-rays and multi-energy electrons. Two possible methods for the simulation of passage of electrons in condensed media are considered. (5 figs, 12 refs) (auth)

25165 (AEC-tr-7314, pp 9-14) CALCULATION OF ABSORBED ENERGY AND SPECTRAL ANGULAR DISTRIBUTIONS OF ELECTRONS FOR PASSAGE THROUGH A PLANE LAYER OF THE IRRADIATED MATERIAL BY ELECTRONIC COMPUTER. Mingaleev, G. S.; Terent'ev, B. M. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Some results are presented on calculations based on an M-20 electronic computer program using a continuous slowing down model (for energy) and the Müller theory of multiple scattering (for angle). The calculated energy and angular distributions in aluminum and polyethylene are shown for various thicknesses. For organic materials such as polyethylene and plexiglass, effective values for atomic number and atomic weights are used in the computer program. (GHT)

25166 (AEC-tr-7314, pp 246-255) EFFECT OF THE RADIATION SOURCE SIZE ON THE SHAPING OF THE DOSE FIELD IN REMOTE GAMMA-THERAPY. Galina, L. S.; Sul'kin, A. G. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

The effect of the source diameter on the characteristics of dose distribution was investigated by comparison of dose fields obtained on GUT Co-1200 and RAD-1 apparatus. The construction parameters (with the exception of the diameter of the active part of the γ-radiation source), affecting the form of the isodose curves, are practically identical in this apparatus which permits the comparison of the dose fields obtained. (auth)

25167 MASTER EQUATION APPROACH TO PROPAGATION OF RADIATION THROUGH RANDOM MEDIA. Perina, J.; Perinova, V. (Palacky Univ., Olomouc, Cze.). Czech. J. Phys.; 25: No. 6, 605-618(1975).

Master and Fokker-Planck equations are obtained for radiation propagating through a random medium using the q-c-number correspondence of the coherent state technique. The corresponding equation for the antinormal characteristic function is solved by means of the method of characteristics. The master equation method and the recently developed method based on the Heisenberg equations and quantum characteristic function are shown to be equivalent. Some existence problems for the Glauber–Sudarshan weighting function are discussed. New light is thrown on approximations in the photocounting statistics used earlier. (auth)

25168 MONTE CARLO DOSIMETRY CALCULATION FOR BORON NEUTRON-CAPTURE THERAPY IN THE TREATMENT OF BRAIN TUMORS. Deutsch, O. L. (Massachusetts Inst. of Tech., Cambridge); Murray, B. W. Nucl. Technol.; 26: No. 3, 320-339(Jul 1975).

The ANDY general geometry Monte Carlo code is used to calculate the space-energy distribution of all pertinent components of the dose within a simple head phantom in an idealized therapy configuration at the Massachusetts Institute of Technology Research Reactor. The effects of ^{10}B concentration, gamma-ray contamination of the therapy beam, thermal neutron beam aperture, and surgically formed re-entrant cavities are examined with respect to several clinical criteria for therapeutic efficacy. It is found for the model considered that the maximum effective relaxation length for the thermal neutron fluence is 1.6 to 1.8 cm, which is 30 to 40 percent lower than the infinite medium relaxation length, and thereby indicates the importance of multidimensional boundary effects in this calculation. The fluence-depth characteristics were verified by an experimental irradiation of a tissue-equivalent head phantom with re-entrant cavity, and excellent agreement was observed between measured and calculated results. It was also found that the gamma-ray beam contaminant is not necessarily deleterious to therapeutic efficacy, that a larger aperture thermal neutron beam improves the dose field with respect to some criteria but at the expense of others, and that plausible size variations in the surgically formed cavity do not change the character of the dose field. As a further refinement, a Monte Carlo microdosimetry model is developed and applied to the problem of radiation effects on the cerebral microvasculature by ^{10}B capture reactions in the circulating blood. Qualitative predictions of this model correlate positively with previous clinical experience. (99 figs, 11 tables, 37 refs) (auth)

25169 CHARGED PARTICLES IN A MEDIUM WITH NONHOMOGENEOUS MAGNETIC AND DIELECTRIC PENETRABILITY. Isaev, R. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 66-69(1975). (In Russian).

A study was made of the energy loss by charged particles moving uniformly in a transparent medium with randomly located nonhomogeneous dielectric and magnetic penetrability due to slight dispersion of the electromagnetic field to an optical frequency. Formulas were derived for such particles at different velocities relative to phase velocity of light in the medium, making it possible to study the energy loss as a function of the scale of the inhomogeneity. (tr-auth)

25170 THEORETICAL STUDY OF THE ELECTRONIC STOPPING POWER FOR PLANAR CHANNELING OF IONS. Haymann, P. (Rouen Univ., 76 - Mont-Saint-Aignan (France)). Surf. Sci.; 49: No. 2, 606-626(Apr 1975). (In French).

A new theory which is a generalization of the wave packets method (already used in a dynamic treatment of Auger process previously given in this review) enables the treatment of the electronic stopping power of ions in the case of planar channeling. This theory, undertaken in the frame of optical potential, shows that continuum potential and Born-Mayer form can be uniquely interpreted by a mechanism of tunneling of electrons through the walls of the channel. These walls have, at the vicinity of the ions, the behaviour of a surface. A formulation of the electronic stopping power is given and discussed regarding the experimental evidence. (auth)

Radiation Protection Standards

Refer also to abstracts 24498 and 25168.

25171 (INIS-mf-1716, pp 367-376) THE SAFETY OF NUCLEAR TECHNOLOGY. Hurst, D. G. [nd].

From symposium on energy resources; Ottawa, Ontario, Canada (15 Oct 1973).

In symposium on energy resources, October 15-17, 1973. (Royal Society of Canada, Ottawa, Ontario).

A superficial look is given at the tasks of regulatory bodies in the nuclear power industry, especially as applied to the Canadian situation. (INIS)

25172 (INIS-mf-1767) GENERAL RULES FOR RADIOLOGICAL WORK. (Bergen Univ. (Norway)). [nd]. 38p. (In Norwegian). INIS.

These rules and guidelines are intended to give an elementary introduction to those precautions which must be taken and to the regulations applicable in all radiological work. A brief review is given of Norwegian laws in the field of radiology and the most important radiological terms are explained. The ICRP recommendations are summarized and explained and the biological effects of radiation briefly commented. The general principles of shielding are presented and the general rules for use of radioactive materials and other radiation sources are given. Commentaries to these rules and instructions for disposal of radioactive waste at the University conclude the guidelines. A number of tables giving useful data are included. (INIS)

25173 SYSTEMATIZATION OF VARIABLES AND DESIGNING SETS OF STANDARDS. Skotnikov, V. V.; Fominykh, V. I.; Yudin, M. F. Meas. Tech. (USSR) (Engl. Transl.); 17: No. 9, 1446-1451 (Sep 1974).

Translated from Izmer. Tekh.; 17: No. 9, 83-85(Sep 1974).

A systems approach to the development of new physical standards is proposed, based on general physical concepts pertaining to ionizing radiation in the sense of a field and the sources of that field. It is also based on the assumption that the system of variables and constants describing fields of ionizing radiation is structured on the basis of the existing system of units of measurements. (GHT)

Radiation Source Calibration and Standardization

Refer also to abstract 25168.

25174 (AEC-tr-7314, pp 14-17) CALCULATION OF THE EFFICIENCY OF SPHERICAL SOURCES BY THE TRIAL AND ERROR METHOD (MONTE CARLO METHOD). Djagatspanyan, R. V.; Kosortov, B. I.; Kheifets, L. I.; Osipov, V. B. May 1975. Translated from Radiats. Tekh.; No. 5, (1970).

In radiation technology.

Monte Carlo method calculations are done to determine the efficiency of a spherical source of Beta radiation. The trajectory of an electron in the body of a spherical source is divided into segments Δx, the lengths of which satisfy the conditions of applicability of the Müller theory. Bremsstrahlung is considered using the Bethe-Bloch equation for the average energy loss per segment, and angular scattering is accounted for using the theory of Müller, Launderson, and Gaudsmit. The dependence of the efficiency of spherical sources is shown as a function of their radius for three different methods of calculation. (1 fig, 15 refs) (GHT)

25175 APPARATUS FOR CHECKING WORKING GAMMA DOSIMETERS. Dol, I. I.; Kaya, V. L.; Lapchinskii, B. V. Meas. Tech.; 17: No. 11, 1787-1789(Nov 1974).

Translated from Izmer. Tekh.; No. 11, 89-91(Nov 1974).

An apparatus that provides exposure dose rates from cobalt-60 or cesium-137 gamma rays in the range from 10^{-11} to $5 \cdot 10^{-5}$ A/Kg ($4 \cdot 10^{-8} - 2 \cdot 10^{-1}$ R/sec) is described. It uses three standard gamma-ray sources, which enables one to obtain at a distance of 1 m exposure dose rates of $4.6 \cdot 10^{-2}$, $6 \cdot 10^{-4}$, and $2 \cdot 10^{-6}$ R/sec. The design and operation of the setup are elaborated. (WHK)

25176 ENERGY DISTRIBUTION IN THIN LAYERS OF TISSUE-EQUIVALENT SUBSTANCE IN PASSAGE OF HEAVY CHARGED PARTICLES. Pitkevich, V. A.; Videnskii, V. G. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 20: No. 7, 24-33(Jul 1975). (In Russian).

An analytical method is described for calculation of the distribution function of energy transfered by charged particles to a thin layer of tissue-equivalent substance based on Fourier's transformation. The Monte-Carlo method for thin layers of the tissue equivalent substance from 100 Å to 1000 Å in thickness was used to calculate densities of the distribution functions of transmitted and absorbed energy under conditions of electron balance with proton irradiation with an energy of MeV. The same distribution was obtained for the tissue-equivalent films kept in vacuum; proton energy was 11 MeV. It is shown that with certain conditions of distribution of transmitted and absorbed energy coincide. For proton energies of 0.2, 1.0, and 7.0 MeV densities, distribution functions of transmitted energy to tissue-equivalent layers of 20Å to 1000 Å were calculated. (auth)

25177 DOSIMETRY OF PROTONS WITH ENERGY OF 1000 MeV IN MEDICO-BIOLOGICAL INVESTIGATIONS. Nizkovolos, V. B.; Konnov, B. A.; Senichev, I. Ya.; Karlin, D. L. (Central Scientific-Research Rentgeno-Radiological Inst., Leningrad). Med. Radiol.; 20: No. 7, 19-24(Jul 1975). (In Russian).

On the protonic synchrocyclotron (Leningrad) the beam of protons was formed for medico-biological investigations. The authors described the dosimetry methods of the beam of protons with the energy of 1000 MeV: thermofluorescent, on the basis of LiF, ionizing method and that of induced activity on carbon. TLD-LiF is the most suitable for intraphantom measurements in relative and absolute units. The cumulative absolute error for ionizing and thermofluorescent methods is ∓ 10% in the fields of mixed radiation in irradiation by protons with the energy of 1000 MeV. The dose calculated by the induced activity taking into consideration the energy spectrum of the primary and secondary particles, was underrated by approximately 15 in comparison with the data in TLD-LiF and the ionizing method. (auth)

25178 MEASURING THE ABSOLUTE EMISSION RATES OF 14 MeV NEUTRONS BY ASSOCIATED PARTICLE COUNTING. Ahmad, M.; Chaudhary, M. S. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi). Nucl. Instrum. Methods; 126: No. 2, 309-311(1 Jun 1975).

Associated α-particle counting in the $T(d,n)^4He$ reaction has been used to measure the absolute neutron-emission rate on the 14 MeV Neutron Generator. A 75 μm thick NE 102A plastic scintillator coupled with a 56 AVP photomultiplier tube serves as the charged-particle detector. The contribution of other competing reactions at deuteron energies less than 120 keV is quite small. (auth)

PHYSICS (THEORETICAL)

25179 STRING DYNAMICS FROM ENERGY MOMENTUM CONSERVATION. Aragone, C. (Departemento de Fisica, Universidad Simon Bolivar, Caracas, Venezuela); Deser, S. (Brandeis Univ., Waltham, Mass. (USA). Dept. of Physics). Nucl. Phys., B; 92: No. 2, 327-333(23 Jun 1975).

It is shown, without use of a Lagrangian, that conservation alone fixes both the stress tensor and equations of motion of an a priori arbitrary one dimensional δ distribution to be those of the usual Nambu string model. (auth)

General

25180 (JINR-D1-2-8405, pp 331-335) EXAMPLE OF THE USE OF PARASTATISTICS OF FRACTIONAL ORDERS. Palev, Ch. D. (Inst. of Nuclear Research and Nuclear Power Engineering, Sofia). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25181 (JINR-D1-2-8405, pp 336-340) MATRIX CANONICAL REALIZATION OF THE O(m,n) GROUP OF LIE ALGEBRA. Eksner, P. (Joint Inst. for Nuclear Research, Dubna, USSR); Galichek, M. 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25182 (JINR-E2-8700) MATRIX CANONICAL REALIZATIONS OF THE LIE ALGEBRA O(m,n). II. Casimir Operators. Havlicek, M.; Exner, P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 31p. Dep. NTIS (US Sales Only) $4.75.

The matrix canonical realizations of the Lie algebra of pseudoorthogonal group O(m,n) described are further investigated. The explicit formulas for the values of Casimir operators, which are multiples of identity element in these realizations, are obtained. (auth)

25183 (JINR-E2-8842) CANONICAL REALIZATIONS OF THE LIE ALGEBRAS gl(n,R) AND sl(n,R). II. Casimir Operators. Havlicek, M.; Lassner, W. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 19p. Dep. NTIS (US Sales Only) $4.00.

The eigenvalues of Casimir operators in the canonical realization of gl(n,R) and sl(n,R) presented are expressed by concrete polynomials in parameters characterizing the realization, and some of their properties are derived. (auth)

25184 USE OF INEQUALITIES FOR THE EXPERIMENTAL TEST OF A GENERAL CONCEPTION OF THE FOUNDATION OF MICROPHYSICS. d'Espagnat, B. (Laboratoire de Physique Theorique et Particules Elementaires, Orsay, France). Phys. Rev., D.; 11: No. 6, 1424-1435(15 Mar 1975).

It is pointed out that some already-known inequalities (Bell's inequalities) and some new ones presented here can be used to test experimentally the validity of a general conception of the foundations of microphysics. This conception mainly consists in considering sets of propositions (having the structure of lattices but possibly of non-Boolean ones) and in assuming that, when a proposition is true on a system, S, this constitutes an intrinsic property of S, which can be neither imparted to S nor withdrawn from S as long as S is "isolated." It is shown that, if experiments of the type of those used to test Bell's inequalities turn out to corroborate the quantum-mechanical predictions, such a result could be used in order to invalidate directly the general conception just described. This is done without reference to the general principles of quantum mechanics. More generally, our derivation does not depend for its validity on assuming the truth of any particular physical theory abstracted by induction from experimental knowledge. (auth)

25185 NEW APPROACHES TO THE STUDY OF THE PROPERTIES OF THE GENERALIZED WKB APPROXIMATION. Zhirnov, N. I.; Sokolov, A. A. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 81-86(1975). (In Russian).

In the framework of the new formalism of the generalized WKB method, previously proposed, the problem of bound states in one-dimensional and spherical-symmetric potential wells was examined. The precise conditions for quantization of the energy bonds were derived, and evaluations were made of the errors permitted during the calculation of the eigenvalues of the energy and wave functions in the zero approximation of the method. (tr-auth)

25186 BETHE–SALPETER EQUATION AND CURRENT CONSERVATION. Boehm, M. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 91: No. 3, 494-508(9 Jun 1975).

Current conservation in the form of the Ward identity between the electromagnetic vertex and the propagator implies that the energy dependence of the BS kernel is restricted and that the propagator cannot be chosen independently from the kernel. It is rather determined from the BS kernel in terms of an integral equation. Convolution type, energy-independent kernels are compatible with current conservation. The propagator and form factor resulting from smooth kernels are studied. (auth)

Quantum Field Theories

Refer also to abstracts 25018, 25057, and 25230.

25187 (JINR-D1-2-8405, pp 74-91) LATEST DEVELOPMENT OF QUANTUM FIELD THEORY. Mateev, M. D. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25188 (JINR-D1-2-8405, pp 272-280) INTRINSIC NONLINEAR FIELDS AND POLARIZATION OF VACUUM. Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna, USSR). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25189 (JINR-D1-2-8405, pp 298-304) TRANSLATIONAL-INVARIANT FIELD THEORY WITH SPACE-TIME QUANTIZATION. Donkov, A. D.; Kadyshevskii, V. G.; Mateev, M. D.; Mir-Kasimov, R. M. (Climent Okhidski Univ., Sofia). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25190 (JINR-D1-2-8405, pp 326-330) EXPANSION OF CONFORM-INVARIANT GREEN FUNCTIONS. Zaikov, R. P. (Higher Pedagological Inst., Shumen, Bulgaria). 1974. (In Russian).

From 4th international symposium on high energy and elementary particle physics; Varna, Bulgaria (22 Sep 1974).

In high energies and elementary particles. (Joint Inst. for Nuclear Research, Dubna (USSR)).

25191 (JINR-P2-8813) RENORMALIZATION OF THE WAVE FUNCTION IN CHIRAL THEORIES. Efimov, G. V.; Rutenberg, M. L. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 15p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The additional renormalization of the wave function in the proof of the equivalence theorem in chiral theories is discussed. (auth)

25192 (JINR-P2-8862) COHERENT STATES. 4. Coherent State Representation. Polubarinov, I. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 39p. (In Russian). Dep. NTIS (US Sales Only) $5.00.

Coherent state representation (CSR) in relativistic field theory is introduced in two forms: without and with the supplementary operation Λ^{-1} (which converts symmetrized products into N-ordered ones; Λ operates like the Hilbert transform). The CSR-2 simplifies all the quantities and equations and removes acausality of coefficient functions in N-product decompositions. Λ and Λ^{-1} operate only on initial values. The field operators in the interaction and Heisenberg pictures are represented as operators in CSR for theories of the scalar field and electrodynamic. In terms of the operators any other operators can be written in familiar form. Coherent state expectation values of any operators are obtained simply by application of these representatives to unity. Equations of motion in CSR have usual form of the Yang–Feldman quantum field theory integral equations or of the standard differential equations with non-usual initial values, containing functional derivatives. After Λ^{-1} has removed the acausal quantum corrections they are not regenerated in the course of evolution, and the remaining quantum corrections (i.e., all corrections in CSR-2) are causal. (RWR)

25193 RENORMALIZATION GROUP AND THE SMALL MOMENTUM LIMIT OF FIELD THEORY. Schattner, P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Suzuki,

M. (California Univ., Berkeley (USA). Dept. of Physics). Nucl. Phys., B; 92: No. 1, 125-140(16 Jun 1975).

Renormalization group techniques are developed which, in contrast to those previously discussed, do not involve expanding a massive field theory around its massless limit. The methods are useful in infrared problems. The validity of perturbative expansions of the renormalization group functions is examined in quantum electrodynamics. The technique is illustrated in quantum electrodynamics and in a σ-type model of the pion. (auth)

25194 ASYMPTOTIC BEHAVIOR IN PURE YANG-MILLS THEORY WITH NON-COVARIANT GAUGES. Karowski, M.; Meyer, S. (Freie Univ. Berlin (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., B; 92: No. 1, 158-170 (16 Jun 1975).

The β-function of pure Yang-Mills theory is gauge independent for linear nonsingular renormalizable gauges in lowest order. The vertex functions scale gauge independently in the ultraviolet region for this general class of gauges. (auth)

25195 QUANTUM PERTURBATION THEORY OF SOLITONS. Callan, C. G. Jr.; Gross, D. J. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). Nucl. Phys., B; 93: No. 1, 29-55(14 Jul 1975).

A systematic perturbation theory is developed for amplitudes involving a single soliton (extended finite energy solution of a classical field theory). These methods allow one in principle to compute to any desired order quantum corrections to soliton masses, form factors, and Green functions. The major technical problem encountered is an infrared divergence of the naive perturbation theory rules. This divergence is dominated by a modification of the usual functional methods so as to properly define the soliton as a momentum eigenstate. The extension of these methods to soliton-soliton scattering is discussed. (auth)

25196 CLIFFORD ALGEBRA AND MAXWELL EQUATIONS. Pestov, A. B. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 54-60(1974). (In Russian).

The relation of the Dirac equation with algebraic systems, discovered by the English mathematician Clifford, is well known. This relation is established for Maxwell equations and some consequences of this relation are examined. (tr-auth)

25197 LONG-RANGE INTERACTIONS OF SPINOR PARTICLES BY EXCHANGE WITH THE QUANTA OF A TORSION FIELD. Poznanin, P. I. (All-Union Scientific Research Inst. of Optical-Physical Measurements, Moscow). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 4, 134-135(1975). (In Russian).

The previously derived Lagrangian of the interaction of a torsion field with a spinor field is analyzed by selecting the term describing the self-action of the torsion field since the examination of the interaction of spinor particles is limited to the lowest orders of the perturbation field. (JSR)

25198 STATIC SCALAR AND ELECTROMAGNETIC FIELDS IN THE THEORY OF GRAVITATION. Bronnikov, K. A.; Mel'nikov, V. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 80-91(1974). (In Russian).

The properties of a static spherical-symmetric precise solution for self-consistent systems of Einstein gravitational massless scalar and electromagnetic fields are examined. Equations for the mass and field energy are derived. The application of the metrics derived to black holes in considered. (JSR)

25199 CURVATURE AND TWISTING OF SPACE IN THE DIRAC THEORY. Golubyatnikov, A. N.; Petrosyan, P. A. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 61-64(1974). (In Russian).

Equations are derived expressing the effect of space twisting on particle energy in the Dirac theory. (JSR)

25200 CLASSICAL THEORY OF FIELDS. Landau, L. D.; Lifshitz, E. M. Oxford; Pergamon Press (1975). 413p.

The subject is dealt with in chapters, entitled: the principle of relativity: relativistic Mechanics: charges in electromagnetic fields: the electromagnetic field equations: constant electromagnetic fields: electromagnetic waves: the propagation of light: the field of moving charges: radiation of electromagnetic waves: particle in a gravitational field: the gravitational field equations: the field of gravitating bodies: gravitational waves: relativistic cosmology. (UK)

25201 MASSIVE GRAVITATION AND THE PROBLEM OF THE MUON MASS. Abdullaev, F. Kh. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 70-73(1975). (In Russian)

A model for regularization of pseudoscalor mesodynamics with weak coupling through a nonpolynomial Lagrangian was studied. Renormalization of the primitively divergent diagrams was accomplished. (tr-auth)

25202 PROBLEMS OF FUNCTIONAL DETERMINANT AND FICTITIOUS LAGRANGIAN IN GAUGE THEORIES. Hsu, J. P.; Sudarshan, E. C. G. (Texas Univ., Austin (USA). Center for Particle Theory). Nucl. Phys., B; 91: No. 3, 477-493(9 Jun 1975).

Using the method of Lagrange multiplier fields the fictitious Lagrangian of gauge-fixed gauge theories can be constructed. Different but equivalent forms are obtained depending on the extent to which constraint equations are used. These constructions yield fictitious Lagrangians which restore unitarity and gauge invariance. The usual method of constructing fictitious Lagrangians using the change of gauge conditions under gauge transformations does not always lead to the same fictitious Lagrangian constructed by the above method. They are, however, related by an interchange of fictitious fields and lead to the same amplitudes. A scale transformation of the fictitious fields is also discussed which changes the explicit form of the fictitious Lagrangian but not its amplitudes. In the course of this study certain technical problems in the definition of the functional determinants related to a fictitious Lagrangian are displayed. (auth)

25203 SUBSIDIARY CONDITION IN QUANTUM ELECTRODYNAMICS. Maison, D. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)); Zwanziger, D. (New York Univ., N. Y. (USA). Dept. of Physics). Nucl. Phys., B; 91: No. 3, 425-431(9 Jun 1975).

It is proven that no charged state obtained by applying a local operator to the vacuum can satisfy the Gupta-Bleuler subsidiary condition. The meaning of this result is illustrated in the simple model whereby the vector potential is coupled to an external classical current. Alternative ways of handling the difficulty with the subsidiary condition are listed. (auth)

25204 MICROSCOPIC CALCULATION OF CRITICAL EXPONENTS WITHOUT THE 1/n OR EPSILON EXPANSIONS. Family, F.; Stanley, H. E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). Phys. Lett., A; 53: No. 2, 111-113(2 Jun 1975).

Critical exponents of a Bose system are calculated microscopically without an expansion in $1/n$ or ϵ. As expected, quantum corrections are found to be absent; and the results, to agree with the $1/n$ expansion result, for $n = 2$, to $O(1/n)$. (auth)

25205 POINTWISE BOUNDS FOR EIGENFUNCTIONS OF ONE ELECTRON SYSTEMS. Barnsley, M. F. (Bradford Univ. (UK)). Phys. Lett., A; 53: No. 2, 124-126(2 Jun 1975).

A new method for imposing pointwise upper and lower bounds on eigenfunctions of a class of Schrödinger operators is presented. The method involves bivariational functionals and apparently does not rest on Sobolev-type inequalities. (auth)

25206 HIGHER ORDER VACUUM POLARIZATION FOR FINITE RADIUS NUCLEI. Gyulassy, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., A; 244: No. 3, 497-525(16 Ju

The calculation of the hi[illegible] order, alpha(Z alpha)/sup n/, n greater than or equal to 3, vacuum polarization charge density induced by high-Z nuclei of finite extent is discussed here. The Wichmann-Kroll formalism relating the vacuum polarization charge density to the Green function of the Dirac equation is reviewed with attention drawn to modifications necessary for very large-Z systems (Z greater than 137) encountered in heavy ion collisions. This paper is concerned with the construction of the radial Green functions for the Dirac equation in the field of finite radius nuclei and on the numerical calculation of the higher order vacuum polarization density from those Green functions. Specific calculations are made for muonic Pb and superheavy electronic atoms. The results from these calculations have been published elsewhere but are further elaborated upon here. (auth)

25207 YANG-MILLS FIELDS IN THE GRAVITATIONAL THEORY. III. Group Theoretical Basis of the Gravitational Theory. Burghardt, R. (Univ., Graz). Acta Phys. Austriaca; 39: No. 2, 127-136(1974). (In German).

In support of a work by Utiyama, a gravitational theory was derived by a group-theory method. The theory contains the covariant field magnitudes. A motion equation and conservation laws were studied. (tr-auth)

25208 COVARIANT METHOD OF CALCULATING EFFECTIVE CROSS-SECTIONS IN QUANTUM ELECTRODYNAMICS. Perov, Yu. S. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 31-34(1975). (In Russian).

Consideration is given to a specialized presentation of the amplitudes of the wave functions of electrons and positrons, on the basis of which a method is developed for calculating the elements of the S-matrix in a manner analogous to a previous study, but by means of which it is possible to obtain formulas in covariant designations. (tr-SJR)

25209 COVARIANT METHOD OF CALCULATING EFFECTIVE CROSS-SECTIONS IN QUANTUM ELECTRODYNAMICS. II. Petrov, Yu. S. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 85-88 (1975). (In Russian).

This study is a continuation of a previous study where a specialized presentation of the amplitudes of the wave functions of electrons and positrons is considered by means of which it is possible to calculate the elements of the S-matrix and to obtain formulas in covariant designations. In this study formulas are obtained by means of which it is possible to express exchange terms of an element of the S-matrix by nonexchangeable terms. A method is considered for going from the matrix element to the effective cross section, in which the expression for the cross section can be obtained in explicitly covariant form. (tr-SJR)

Gravitation and General Relativity

Refer also to abstracts 25198, 25199, and 25207.

25210 CONFORMAL INVARIANT GENERAL RELATIVITY WITH DYNAMICAL SYMMETRY BREAKDOWN. Englert, F.; Gunzig, E.; Truffin, C.; Windey, P. (Brussels Univ. (Belgium). Faculte des Sciences). Phys. Lett., B; 57: No. 1, 73-77(9 Jun 1975).

A conformal invariant theory of gravitation is proposed which matches general relativity in the classical limit. It implies a dynamical origin for mass and a selection rule on "elementary" matter constituents. It is conjectured that the theory is renormalizable. (auth)

25211 GRAVITATIONAL WAVES IN THE FIELD OF A COLLAPSING STAR. Sibgatullin, N. P.; Alekseev, G. A. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 142-153(1974). (In Russian).

Second order equations are introduced for each of the invariants of the Riemann tensor of interferring fields and the general forms for their solution in the vicinity of the gravitational radius were found. Correct conditions for the joining of the solutions were used for the simultaneous solution of the external and internal problems. The asymptotic behavior of the gravitational wave emitted by the distant point sources in the Schwarzschild field and also within the homogeneous dust-like star creating this field was studied. (JSR)

25212 RELATION BETWEEN CENTRAL AND COMOVING FRAMES OF REFERENCE AND PRINCIPLES OF COVARIANCE IN COSMOLOGICAL MODELS OF THE GENERAL THEORY OF RELATIVITY. Stanyukovich, K. P. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 123-141(1974). (In Russian).

On the basis of an analysis of the basic equation of gravitational fields in spherical-symmetric metrics it is concluded that the Einstein concept on the possible existence of a finite closed limitless spherical space is unjustified. There is not semi-closed universe. The different theoretical constructions of two space are illusory since they are based on unacceptable coordinate transforms. (JSR)

25213 GRAVITATIONAL RADIATION OF A SYSTEM OF TWO BODIES OF RANDOM FORM. Fedorova, S. P. (Kazakh State Univ., Alma-Ata, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 47-51(1975). (In Russian).

An expression is derived in the $(v/c)^5$ approximation for the energy of the gravitational radiation for a system of two rotating bodies. (JSR)

25214 EFFECT OF RADIATION REACTION FORCE ON A PARTICLE IN A KERR FIELD. Khalilov, V. R.; Chizhov, G. A. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 87-90(1975). (In Russian).

The model example of the radiation of the scalar waves of particles moving along one of the stable orbits in the equatorial plane of a Kerr gravitational field is studied. The emphasis is on the qualitative aspects of the problem. (JSR)

25215 PRINCIPLE OF THE CONSTANCY OF THE SPEED OF LIGHT IN THE GENERAL THEORY OF RELATIVITY. Kiriya, V. S. (Tbilisi State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 72-76(1975). (In Russian).

It was shown that the principle of the constancy of the speed of light (law of c = const.) occurs in an arbitrary accelerated frame of reference in the absence and presence of a gravitational field. An explanation of the San'yak experiment was given on the basis of the law c = const., which removes the contradiction of this law with an assumption on the existence of a privileged frame of reference. (tr-auth)

25216 OTHER PHYSICAL SPACES. Gertsenshtein, M. E.; Stanyukovich, K. P. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 162-167(1974). (In Russian).

It is shown that the existence of other external spaces and the change of the topology with time confirms the general theory of relativity. (JSR)

25217 GEOMETRIC QUANTIZATION OF SCHWARZSCHILD METRICS. Pilipenko, V. A. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 120-122(1974). (In Russian).

Schwarzschild metrics are examined in the static and spherical-symmetric coordinates by the canonical approach. The three basic problems of the canonical approach (general covariance, form of the momentum operator, and sequence of the operators with respect to each other) are solved explicitly by the postulation that such an operator is the product of two linear dimensions. (JSR)

25218 QUANTIZATION OF AN INTERVAL IN RIEMANN SPACE WITH GRAVITATIONAL AND WEAK INTERACTIONS AND RELIC RADIATION. Stanyukovich, K. P. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 106-120(1974). (In Russian).

On the basis of purely heuristic assumptions equations are derived for fundamental quantum lengths. The effect of the introduction of fundamental lengths on the quantization of gravitational fields is examined. A physical model by which (virtual) gravitons for static fields can be introduced is also examined. (JSR)

25219 NON-LINEAR FIELDS IN THE THEORY OF GRAVITATION. Shikin, G. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 101-106(1974). (In Russian).

Nonlinear equations of massless scalar fields, corresponding to a Lagrangian containing a nonlinear term in the form of the product of the square of the gradient of the field function were examined with consideration of inherent gravitational fields. The static spherical-symmetric solutions of these equations were obtained. It was shown that if in the two-dimensional case the solution has a divergence at zero then consideration of the inherent gravitational field does not eliminate this divergence. (JSR)

25220 SOME SOLUTIONS OF THE EQUATION OF THE INTERACTION OF SCALAR AND ELECTROMAGNETIC FIELDS IN AN EXTERNAL GRAVITATIONAL FIELD. Shikin, G. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 98-101(1974). (In Russian).

Precise spherical-symmetric solutions were obtained for two forms of the equation for the interaction of scalar and electromagnetic fields in an external gravitational field. Its metrics are a special case of the metrics of the scalar-tensor theory of gravitation. (tr-auth)

25221 SPECTRAL PROBLEMS FOR SYSTEMS OF EINSTEIN AND KLEIN-GORDON EQUATIONS. Solodov, A. A. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 92-97(1974). (In Russian).

The particulate stationary spherical-symmetric solutions of the Einstein and Klein-Gordon equations are investigated. The spectrum of solutions is fixed by conditions on the charge N and Tolman J_T integrals. It was shown that the conditions $N = 1$, $J_T < \infty$ reduces to a continuum and the conditions $N = 1$, $J_T = M$ reduces to a discrete spectrum of the observed mass M. (tr-auth)

25222 CIRCULAR ORBITS IN TWO-PARTICLE DYNAMICS TAKING INTO CONSIDERATION THE INTERACTION DELAY. Zhdanov, V. I.; Piragas, K. A. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 65-80(1974). (In Russian).

Two cases of circular orbits are examined. The first is when a light body achieves a circular orbit in the field of a heavy body and then, with a great degree of precision, the problem is reduced to the problem of one strong center and the movement of the light body is described by means of geodesics in the field of the heavy body. In the second case when the masses of the bodies are commensurate, both bodies achieve movement with respect to some point. This second case is examined using the theory of direct interaction taking into consideration the delay of signals. (JSR)

25223 LIMITING POSSIBILITIES OF THE DICKE METHOD IN EXPERIMENTS FOR THE VERIFICATION OF THE EQUIVALENCE PRINCIPLE. Kolosnitsyn, N. I.; Nedosekin, Yu. A. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 200-206(1974). (In Russian).

In experiments for the verification of the equivalence principle, using the Dicke method, it is necessary to take into consideration the effect of the gradients of the solar gravitational field which creates interferences synchronous with the measured signals and can significantly reduce the efficiency of the method. (JSR)

25224 HOLONOMIAL GROUPS AND RECURRENT TENSOR FIELDS IN LORENTZ SPACE. Aleskeevskii, D. V. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 5-17(1974). (In Russian).

Some applications of holonomial groups in the general theory of relativity are discussed. The basic definitions and constructions comparing each two-dimensional sphere in Lorentz space with

holonomial groups are reported. It was shown that the description of all recurrent tensor fields in a space with a given holonomial group is reduced to the number of algebraic problems in the calculation of the inherent tensors at a given point. The relation between the holonomial groups and the curvature tensors was established and some spaces of curvature tensors and Ricci tensors were determined. A list was given of all holonomial algebras of Lorentz space and the general form of the space metrics was indicated. (tr-auth)

25225 EXTRINSIC FORMS OF CURVATURE IN PSEUDO-RIEMANN EINSTEIN SPACE. Nikolaenko, V. M. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 17-24(1974). (In Russian).

A review is given of some data from the theory of extrinsic forms. The generalization of the wave equations is examined. Data from the theory of holonomial groups, which can be used during the study of the curvature tensor, are reported. (tr-auth)

25226 METHODS OF DOUBLE KINEMATIC INVARIANT MAGNITUDES AND OF GRAVITATIONAL WAVES. Vladimirov, Yu. S.; Efremov, V. N. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 24-33(1974). (In Russian).

Two methods of assigning the frame of reference are examined. In the first the frame of reference is assigned by a monad-vector field tangent to the congruence of the world line of the reference body. In the other method it is assigned by the elimination of a subclass of coordinate transforms. (JSR)

25227 WEYL GEOMETRY IN THE THEORY OF SCALAR-TENSOR GRAVITATION FIELDS. Gonyaev, V. V. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 33-49(1974). (In Russian).

The conform-invariant model of scalar-tensor gravitational fields is generalized. This model can be considered a generalization of the classical Einstein theory based on the requirements of invariance with respect to the groups of conform transforms and general covariance. (JSR)

25228 CONFORM GROUP IN POINCARE BASE. Leznov, A. N.; Fedoseev, I. A. Probl. Teor. Gravitatsii Elem. Chastits; No. 5, 49-54(1974). (In Russian).

Conform-invariant gravitational theories of the Hoyle-Narlikar type have received much study. In some special cases an expansion of the representation of the conform group was found by a representation of the Poincare group. A general method for such expansions is given. It is based on the realization of the representation of the conform group in a space of Poincare group functions. (JSR)

25229 TENSOR, MATRIX, AND VECTOR POTENTIALS IN GRAVITATIONAL THEORIES. Raigorodski, L. D. (Department of Physics, Leningrad Shipbuilding Institute, Leningrad, USSR). Phys. Lett., A; 53: No. 2, 127-128(2 Jun 1975).

In the general theory of relativity characteristics of the gravitational field are identified with geometrical characteristics of curved (in the presence of gravitating objects) space–time. The components of the metric tensor g_{ik} are Einstein gravitational potentials, and the element of space–time interval is given by $ds^2 = -g_{ik}\, dx^i dx^k$. Components of metric tensor may be represented in the matrix form with help of Dirac matrices: $\hat{\Gamma} \cdot g_{ik} = \frac{1}{2}(\hat{\gamma}_i\hat{\gamma}_k + \hat{\gamma}_k\hat{\gamma}_i)$, where $\hat{1}$ is a unit matrix. (auth)

25230 YANG–MILLS FIELDS IN GRAVITATIONAL THEORY. II. Yang–Mills Field and Geometry. Anholonomic Theory. Burghardt, R. (Univ., Graz). Acta Phys. Austriaca; 39: No. 1, 31-40(1974). (In German).

Riemann geometry was enriched with rotation effects by use of anholonomic 4-spurs. By use of an invariant transformation Yang-Mills fields occur which describe the shearing and expansion effects in the gravitational field and contain coriolis and gravity forces. (tr-auth)

25231 ELECTROMAGNETIC RADIATION IN WEAK GRAVITATIONAL FIELDS. Schmid, W. M. (Univ., Vienna). Acta Phys. Austriaca; 39: No. 2, 172-179(1974).

The radiated energy of a charged particle falling freely in a static weak gravitational field is examined in its dependence on the components of the metric tensor. (auth)

REACTOR TECHNOLOGY AND REGULATION

25232 WE WILL USE NUCLEAR ENERGY FOR ECONOMIC DEVELOPMENT. Ramanna, R. (Bhabha Atomic Research Centre, Bombay). Chem. Eng. World; 9: No. 7, 59-62(Jul 1974).

Progress of India's nuclear power programme is briefly outlined. Contributions of the Bhabha Atomic Research Centre in making nuclear energy, in the form of radioisotopes and radiations, useful to the Indian industries and medicine are mentioned with illustrations. It is emphasised that the creation of proper research environment and congenial working surroundings has played a large role in the success of research programmes of the atomic energy establishments in India. (INIS)

25233 DR. SETHNA SPEAKS OF INDIA'S NUCLEAR POWER PROGRAMME. Shah, J. (Industrial Publications, Bombay). Chem. Eng. World; 9: No. 7, 53-58(Jul 1974).

The interview with Dr. Sethna, Chairman, Indian Atomic Energy Commission, in connection with India's peaceful nuclear experiment (PNE) of a nuclear device and atomic energy programme is reported. PNE, it is emphasised, is only a part of India's continuing experimental programme to explore peaceful uses of nuclear energy. It is pointed out that nuclear energy cannot solve all the problems of India but is a useful adjunct in the total picture. Contribution of India's atomic energy activities to various fields are mentioned with illustrations. (INIS)

25234 SOUTH AFRICA'S FIRST NUCLEAR POWER STATION. Hirschman, B. Power Plant South. Afr.; No. 4-5, 29-30(Jan 1975).

A milestone in South Africa's atomic history will be the erection of the country's first nuclear power station near Cape Town. Koeberg "A" will initially house two reactors of similar design with a combined generating capacity of about 2000 MW, the first of which is planned for commercial service by 1982. The second will probably follow one or two years later. The Koeberg "A" power station and its consequences are discussed. (INIS)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 25372, 25376, 25377, 25382, and 25395.

25235 (NEDO-10871) TECHNICAL DERIVATION OF BWR 1971 DESIGN BASIS RADIOACTIVE MATERIAL SOURCE TERMS. Skarpelos, J. M.; Gilbert, R. S. (General Electric Co., San Jose, Calif. (USA). Atomic Power Equipment Dept.). Mar 1973. vp. General Electric Co., San Jose, CA.

General Electric Company has evaluated radioactive material source terms in operating boiling water reactors (BWRs) over the past decade. These source terms are continually reviewed. The source terms used in design documents are periodically revised to incorporate new information. This report reviews the 1971 radioactive material source terms and explains their derivation. (5 references) (auth)

25236 (SAND-75-5012) DYNAMIC NONLINEAR ANALYSIS OF SHELLS OF REVOLUTION. Von Riesemann, W. A.; Stricklin, J. A.; Haisler, W. E. (Sandia Labs., Albuquerque, N. Mex. (USA); Texas Agricultural and Mechanical Univ., College Station (USA). Dept. of Aerospace Engineering). 1975. 16p. (CONF-750908-1). Dep. NTIS $4.00.

From 3rd international conference on structural mechanics in reactor technology; London, UK (1 Sep 1975).

A description is given of calculations employing DYNAPLAS II which uses the "displacement" method of analysis in which the nonlinearities are treated as pseudo loads on the right-hand side of the equations of motion. The equations are written for each Fourier harmonic used in representing the asymmetric loading components, and although the left-hand side of the equations is uncoupled, the right-hand side is coupled by the nonlinear pseudo loads. The strain displacement equations of Novozhilov are used and the incremental theory of plasticity is used with the von Mises yield condition and associated flow rule. Either isotropic work hardening or the mechanical sublayer model (an assemblage of elastic perfectly plastic layers) may be used. In addition, strain rate effects may be included. Two temporal integration methods are available; either the explicit central difference method or the implicit Houbolt method. A closed form solution for the elastic-plastic behavior of rings subjected to axisymmetric impulsive loading was used as a check problem. (auth)

25237 (WCAP-8456) HEAVY SECTION STEEL TECHNOLOGY PROGRAM TECHNICAL REPORT NO. 38. Fracture Toughness Characterization of HSST Intermediate Pressure Vessel Material. Mager, T. R.; Yanichko, S. E.; Singer, L. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1974. 43p. Dep. NTIS $5.00.

For Oak Ridge National Lab., TN.

The primary objective of the Heavy Section Steel Technology (HSST) Program is to develop pertinent fracture technology to demonstrate the structural reliability of present and contemplated water-cooled nuclear reactor pressure vessels. In order to demonstrate the ability to predict failure of large, heavy-walled pressure vessels under service type loading conditions, the fracture toughness properties of the vessel's materials must be characterized. The sampling procedure and test results are presented for vessel material supplied by the Oak Ridge National Laboratory that were used to characterize the fracture toughness of the HSST Intermediate Test Vessels. The metallurgical condition and heat treatment of the test material was representative of the vessel simulated service test condition. Test specimen locations and orientations were selected by the Oak Ridge National Laboratory and are representative of flaw orientations incorporated in the test vessels. The fracture toughness is documented for the materials from each of the eight HSST Intermediate Pressure Vessels tested to date. 7 references. (auth)

25238 FEEDWATER PURIFICATION SYSTEM FOR A STEAM POWER PLANT WITH BOILING-WATER REACTOR. Heitmann, H. G.; Knorlein, R. (to Siemens Aktiengesellschaft). US Patent 3,894,391. 15 Jul 1975. Priority date 22 Aug 1972, F. R. Germany. 4p.

A feedwater purification system is described for a steam power plant having a boiling-water reactor. It includes a condenser and regenerative preheater means connected in the system, a feedwater tank connected in the system with the condenser and the regenerative preheater means, and high-pressure preheater means connected with the feedwater tank downstream. Purification equipment and electromagnetic filter means are connected in the system downstream of the condenser in direction of feedwater flow therethrough. A circulation pump is serially connected with the electromagnetic filter means, the series connection of the circulation pump and the electromagnetic filter means connected in parallel to the feedwater tank, to the high-pressure preheater means and to a series connection of the high-pressure preheater means. (Official Gazette)

25239 SPRING AND STOP ASSEMBLY FOR NUCLEAR FUEL BUNDLE. Curulla, M. V.; Smith, B. A.; Ashton, J. A. (to General Electric Co.). US Patent 3,878,042. 15 Apr 1975. Filed date 12 Sep 1973. 6p.

A removable spring and stop assembly is described for use with a nuclear fuel bundle in a nuclear reactor core. The assembly includes a bolt threaded through a top section of a stop member by which the assembly (and a flow channel) is secured to the fuel bundle, the adjacent end threads of the bolt. The stop member is upset or deformed by which the bolt is captured in the assembly. (Official Gazette)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 25236, 25237, 25306, 25362, 25363, 25377, 25382, 25391–25395, 25477, 25486–25489, and 25491.

25240 (CENPD-155-A) SURVEILLANCE SPECIMEN HOLDER. C-E Procedure for Design, Fabrication, Installation, and Inspection. Koziol, J. J.; Houstroup, J. P.; Ayers, D. J.; Kosky, R. P. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Jun 1975. 121p. Combustion Engineering, Inc., Windsor, CT.

Combustion Engineering procedures for the design, fabrication, installation, and inspection of material surveillance specimen holder assemblies are described. These holder assemblies contain test specimens taken from the reactor vessel plate material and are attached to the vessel cladding in the beltline region. (JWR)

25241 (WCAP-7924-A) BASIS FOR HEATUP AND COOLDOWN LIMIT CURVES. Hazelton, W. S.; Anderson, S. L.; Yanichko, S. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Energy Systems Div.). Apr 1975. 49p. Westinghouse Electric Corp., Pittsburgh.

A description is presented on how the provisions of Appendix G to Section III of the ASME Code (Summer 1972 Addenda) are used by Westinghouse Electric Corporation's Nuclear Energy Systems Division to develop the pressure-temperature limits for normal operation and core operation that is included in the Technical Specifications. The methods used to conservatively estimate the required material properties in those cases where material was procured and tested prior to the application of the expanded test requirements are also described. (auth)

25242 (XN-75-27-NP) EXXON NUCLEAR NEUTRONIC DESIGN METHODS FOR PRESSURIZED WATER REACTORS. Skogen, F. B. (Exxon Nuclear Co., Richland, Wash. (USA)). Aug 1975. 147p. Exxon Nuclear Co., Inc., Richland, WA.

The Exxon Nuclear neutronic design calculational methods are described along with the results obtained when these methods are compared to experimental measurements. The discussion of the calculational methods includes descriptions of the basic computer codes and the procedures for applying these codes. Comparisons of calculations against measurements are performed using the same codes and computational methods as are used in standard PWR neutronic design efforts. The Appendices include a discussion of the basic cross section library and discussions of the PWR neutronics design computer codes. (auth)

25243 FAILED FUEL DETECTOR. Martucci, J. A. (to Combustion Engineering, Inc.). US Patent 3,878,040. 15 Apr 1975. Filed date 20 Sep 1973. 6p.

A failed fuel detection apparatus is described for a nuclear reactor having a liquid cooled core comprising a gas collection hood adapted to engage the top of the suspect assembly and means for delivering a stripping gas to the vicinity of the bottom of the suspect fuel assembly. (Official Gazette)

25244 COMPACT NUCLEAR REACTOR. Juric, S. I. (to Babcock Wilcox Co.). US Patent 3,888,734. 10 Jun 1975. Filed date 15 Jun 1971. 6p.

A compact nuclear reactor of the pressurized-water variety is described which has two separate parts separably engageable for ease of inspection, maintenance and repair. One of the parts is a pressure vessel having an active core and the other of the parts is a closure adapted on its lower surface with an integral steam generator. An integral pump, external pressurizer and control rods are provided which communicate with the active core when engaged to form a total unit. (Official Gazette)

25245 CREEP COLLAPSE OF PWR FUEL CLAD. Howl, D. A. (United Kingdom Atomic Energy Authority, Springfields, Eng.). pp 13-21 of Fuel Element Analysis. Rashid, Y. R. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-17.

The time at which an empty length of nuclear fuel clad collapses unstably under an external pressure can be calculated by solving the von Mises equation using reduced moduli from isochronous stress-strain relationships. This method has given predictions which are in satisfactory agreement with experimental results. Experimental results from out-of-reactor tests on long lengths of PWR clad are given, and these results are compared with predictions. The method can be extended to short lengths of clad, and hence used to calculate the maximum gap between pellets which can be tolerated during in-reactor operation. Examples of such predictions for PWR clad are given. (auth)

25246 RELIABILITY ASSESSMENT OF ASME CODE EQUATIONS FOR NUCLEAR COMPONENTS. Ravindra, M. K.; Singh, A. K. (Sargent and Lundy, Chicago). pp 29-36 of Reliability Engineering in Pressure Vessels and Piping. Gangadharan, A. C. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-18.

A methodology to calculate the reliabilities inherent in the ASME code equations for the design of nuclear components is described. The uncertainties in applied loads on the components and in the mechanical properties of materials are evaluated using available models and data. Typical examples selected from nuclear piping are included to illustrate the proposed method. Finally, it is shown how design rules for nuclear components may be developed to achieve consistent reliabilities. (auth)

25247 RELIABILITY OF SLIGHTLY OVAL CYLINDRICAL SHELLS AGAINST ELASTIC-PLASTIC COLLAPSE. Morales, W. J.; Duke, M. M.; Mazumdar, M. (Westinghouse Electric Corp., Tampa, FL). pp 37-49 of Reliability Engineering in Pressure Vessels and Piping. Gangadharan, A. C. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-18.

The increasing concern of the engineering profession to adequately establish structural safety has led to the realization that every structure has a small but finite probability of failing to perform its intended duty. Such conclusion has led to the application of statistical/probabilistic methods to characterize structural reliability gradually replacing the conventional safety factor approach which views structural adequacy as either being satisfactory or not. A more refined structural reliability approach is to incorporate into the statistical assessment of safety the effect of such factors as errors in the mathematical model describing structural strength, human errors, etc. Such an approach is termed the Extended Reliability Principle. The reliability of a slightly oval cylindrical shell under the action of a uniform external pressure is assessed against elastic-plastic collapse using the Monte Carlo Importance Sampling Approach and the Extended Reliability Principle. The analysis illustrates the use of statistical analysis and reliability theory in assessing reliability and in determining the effect of parameters such as external pressure and ovality to provide safety without excessive conservatism. (auth)

25248 ROLE OF RADIATION ON THE RELIABILITY OF NUCLEAR REACTOR PRESSURE VESSELS. Steele, L. E. (Naval Research Lab., Washington, DC). pp 89-104 of Reliability Engineering in Pressure Vessels and Piping. Gangadharan, A. C. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-18.

The future of nuclear power depends largely upon assurance of reliability. The primary pressure boundary, especially the core region pressure vessel, must withstand the usual service conditions plus neutron radiation. The role of radiation is to embrittle, harden, and strengthen the steel used in the pressure vessel. A review is presented of the critical factors associated with radiation embrittlement and the measures which might be taken to minimize this effect thereby enhancing system reliability in future nuclear systems. The implications for reliability of water reactors are reviewed in a summary. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 25370 and 25490.

25249 (GA-A-13514) FORT ST VRAIN SURVEILLANCE AND TESTING PROGRAM. Quarterly Progress Report for the Period Ending June 30, 1975. (General Atomic Co., San Diego, Calif. (USA)). 31 Jul 1975. Contract AT(04-3)-167. 3p. Dep. NTIS $4.00.

25250 (GA-A-13553) EFFECTS OF SERVICE ENVIRONMENTS ON THE BEHAVIOR OF HTGR STEAM GENERATOR STRUCTURAL MATERIALS. Mazandarany, F. N.; Rittenhouse, P. L. (General Atomic Co., San Diego, Calif. (USA)). 15 Jul 1975. Contract AT(04-3)-167. 41p. (CONF-750911-6). Dep. NTIS $5.25.

From international conference on materials for nuclear steam generators; Gatlinburg, Tennessee, USA (9 Sep 1975).

The literature pertinent to water and steam corrosion of principal HTGR steam generator materials is reviewed. It is shown how this information is taken into account in the design of HTGR steam generators in the form of corrosion allowances, where required. Similarly, the available information relevant to HTGR primary coolant-metal compatibility is reviewed. Test results from on-going primary coolant compatibility studies are presented and interpreted in terms of a qualitative mechanistic model. (auth)

25251 (LA-UR-75-1321) ZrC, A KEY INGREDIENT FOR HIGH TEMPERATURE NUCLEAR FUELS. Wagner, P.; Hollabaugh, C. M.; Bard, R. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 13p. (CONF-751007-4; SM-200/18). Dep. NTIS $4.00.

From IAEA international meeting on gas-cooled reactors; Juelich, F. R. Germany (13 Oct 1975).

There are two basic reasons for modifying coated fuel particles for GCR use. The first is to increase the fuel body heat treatment temperature limit in order to make a higher lambda fuel matrix, the second is to raise the particle operating temperature limit. Replacement of SiC by ZrC has the potential of serving these two purposes. Predictable, controllable, and reproducible ZrC-containing particle coats have been made using the LASL-developed

$ZrCl_4$ powder feeder. These coats have been made as discrete layers of ZrC or as various combinations of co-deposits of isotropic pyrolytic carbon and ZrC. The fabrication of these coats is described in detail. Irradiation tests have been performed on TRISO type particles with ZrC and on particles with gradations in the ZrC concentration in the coat. These particles had inert kernels. Test results have also been reported on TRISO particles with fissile kernels. The results of all these tests have been satisfactory. LASL-made fissile coated particles with C-ZrC graded coats, and ZrC coated particles with carbon kernels and variable stoichiometry in the ZrC are currently being irradiated. Thus far, all laboratory and high temperature irradiation test results on the ZrC containing coated particles look as good as or better than comparable test results on SiC containing particles. At this point in time, indications are that ZrC coated particles will fulfill their promise in extending the high temperature limit in gas cooled reactors. (auth)

25252 (UNI-SA-13) N REACTOR STEAM GENERATOR PERFORMANCE. Carlson, P. A.; Kratzer, W. K.; Larrick, A. P.; Schmidt, J. P. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 4 Aug 1975. Contract AT(45-1)-1857. 17p. (CONF-750911-4). Dep. NTIS $4.00.

From international conference on materials for nuclear steam generators; Gatlinburg, Tennessee, USA (9 Sep 1975).

A description is given of the performance of the twelve N Reactor steam generators. Maintenance and modifications carried out during the operating history of the reactor are discussed. (DG)

25253 HIGH TEMPERATURE HELIUM-GAS-COOLED REACTOR. Crimmins, D. H. (Gulf General Atomic Co., San Diego, CA). pp 1-13 of Applications of Cryogenic Technology. Vol. V. Carr, R. H. (ed.). Whitestone, NY; Scholium International, Inc. (1973).

From 5th annual conference of the Cryogenic Society of America; Chicago, Illinois, USA (3 Oct 1972). See CONF-721023-.

The High Temperature Helium-Gas-Cooled Reactor (HTGR) plant provides a number of significant advantages to electric utilities over other types of thermal power plants. Less heat must be rejected to the environment because of the efficient high temperature steam produced, made possible because of the high temperature operation of the helium-cooled graphite core structure. Maintenance is eased by the noncorrosive properties of helium, and radioactive releases to the environment are virtually eliminated because all radioactive products can be removed from the helium by means of cryogenic systems. The general design of a 1150 MWe HTGR reactor system, completely enclosed within the prestressed concrete reactor vessel is described. (auth)

25254 NUCLEAR FUEL ELEMENT ASSEMBLIES. Statham, E. (to United Kingdom Atomic Energy Authority). US Patent 3,873,420. 25 Mar 1975. Priority date 28 Sep 1971, United Kingdom of Great Britain and Northern Ireland. 2p.

A fuel element assembly for a high temperature reactor comprises a prismatic block having fuel containing bores and interstitial coolant conducting bores extending end-to-end. The fuel comprises stacks of annular compacts which line the fuel containing bores and define central coolant flow channels through the fuel. (Official Gazette)

25255 HTGR POWER PLANT HOT REHEAT STEAM PRESSURE CONTROL SYSTEM. Braytenbah, A. S.; Jaegtnes, K. O. (to Westinghouse Electric Corp.). US Patent 3,894,394. 15 Jul 1975. Filed date 22 Apr 1974. 28p.

A control system for a high temperature gas cooled reactor (HTGR) power plant is disclosed wherein such plant includes a plurality of steam generators. Dual turbine-generators are connected to the common steam headers, a high pressure element of each turbine receiving steam from the main steam header, and an intermediate-low pressure element of each turbine receiving steam from the hot reheat header. Associated with each high pressure element is a bypass line connected between the main steam header and a cold reheat header, which is commonly connected to the high pressure element exhausts. A control system governs the flow of steam through the first and second bypass lines to provide for a desired minimum steam flow through the steam generator reheater sections at times when the total steam flow through the turbines is less than such minimum, and to regulate the hot reheat header steam pressure to improve control of the auxiliary steam turbines and thereby improve control of the reactor coolant gas flow, particularly following a turbine trip. (Official Gazette)

25256 NUCLEAR REACTOR POWER PLANT. Hosegood, S. B. (to United Kingdom Atomic Energy Authority). US Patent 3,897,838. 5 Aug 1975. Priority date 6 Aug 1969, United Kingdom of Great Britain and Northern Ireland. 4p.

A nuclear power plant has a main prestressed concrete pressure vessel housing the core, and, in pods, the heat exchangers, low power turbine, circulators, etc., but a separate pressure vessel for the power turbine connected to the main vessel for the supply of working fluid. A greater flexibility of plant layout results, for the position of the turbo-alternator line is independent of the main vessel. (Official Gazette)

25257 PRESSURE RELIEF SYSTEM FOR A NUCLEAR REACTOR. Fay, H. P.; Peck, W. S. (to General Atomic Co.). US Patent 3,889,707. 17 Jun 1975. Filed date 19 Nov 1971. 10p.

A pressure relief and secondary containment system is described for containing an increase in pressure without leaking contaminants to the ambient atmosphere. A first containment enclosure is provided, which may be a building housing a nuclear reactor or a chemical processing system or the like which is capable of releasing contaminants in the event of an accident. A remote evacuated vessel or second containment enclosure is also provided. The first containment enclosure is relieved, in the event of an increase in pressure therein, to the second containment enclosure through a pressure regulating fluid seal. The fluid seal maintains a pressure differential between the first and the second containment enclosures during normal conditions. (Official Gazette)

25258 PRESSED BLOCK FUEL ELEMENTS FOR GAS COOLED HIGH TEMPERATURE POWER REACTORS AND PROCESSES FOR THEIR PRODUCTION. Hackstein, K. G.; Hrovat, M. (to Nukem G,m,b,H.). US Patent 3,891,502. 24 Jun 1975. Priority date 14 Feb 1972, F. R. Germany. 6p.

Block fuel elements for high temperature power reactors that can be reprocessed simply are prepared in which the feed and breed zones are connected with the graphite matrix directly and without transition. They are disposed separately from each other in such a manner that the feed zones and the breed zones can be separately removed one after the other from the structural graphite. In the reprocessing operation there are recovered uranium 233 from the breed particles, uranium 235 and fission products from the feed particles. (Official Gazette)

Power Reactors, Non-Breeding, Otherwise Moderated

25259 (CONF-750558-1) SURGE TANK PRESSURE TRANSIENTS DURING MULTIPLE SURGES. Cheng, S. C.; Gorman, D. J.; Kulkarni, K. (American Society of Mechanical Engineers, New York). 1975. 5p. ASME, New York, NY. $3.00.

From joint fluids engineering and lubrication conference; Minneapolis, Minnesota, USA (5 May 1975).

A thermodynamic analysis for surge tank pressure transients during multiple surges in a nuclear reactor is presented. A sinusoidal type of level changes has been assumed. (auth)

25260 NUCLEAR POWER IN CANADA. Perryman, E. C. W. (Atomic Energy of Canada Ltd., Chalk River, Ontario). pp 28-51 of Applications of Cryogenic Technology. Vol. V. Carr, R. H. (ed.). Whitestone, NY; Scholium International, Inc. (1973).

From 5th annual conference of the Cryogenic Society of America; Chicago, Illinois, USA (3 Oct 1972). See CONF-721023-.

A brief historical review of the Canadian Power Reactor Program is given, covering heavy-water moderated reactors cooled with heavy water, light water, and organic liquid. The experience obtained from two prototypes, NPD (Nuclear Power Demonstration) and Douglas Point, is discussed in relation to the first year's successful operation of the Pickering Nuclear Power Station. Future improvements and trends in the CANDU family of reactors are described. (auth)

25261 FULMOD: AN INELASTIC ANALYSIS PROGRAM TO PREDICT THE OPERATING BEHAVIOUR OF CANDU FUEL ELEMENTS. Too, J. J. M. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Hsu, T. R.; Bertels, A. W. M. pp 23-35 of Fuel Element Analysis. Rashid, Y. R. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-17.

The usual linear-elastic stress analysis procedures are not adequate for modelling the behavior of operating fuel elements because of transient temperature conditions and the time-temperature dependent geometry and material properties. A multi-dimensional, finite element, thermal-elasto-plastic analysis code called FULMOD has been developed to cope with such conditions. This code determines transient temperature distribution using a step-by-step time incremental procedure. This distribution is subsequently used to calculate deformation and stress

using a mixed variable stiffness and one-step stress correction method. A method for modelling fuel/sheath interface is proposed, and results obtained from the FULMOD code are compared with experimental observations of element ridging. (auth)

Power Reactors, Breeding

Refer also to abstracts 24433, 25298, 25359, 25360, 25365, 25369, 25371, 25380, 25381, 25384, 25385, and 25494.

25262 (ANL-75-33) APPLICATION OF THE COLLOCATION METHOD USING HERMITE CUBIC SPLINES TO NONLINEAR TRANSIENT ONE-DIMENSIONAL HEAT-CONDUCTION PROBLEMS. Chawla, T. C.; Leaf, G.; Chen, W. L.; Grolmes, M. A. (Argonne National Lab., Ill. (USA)). Jul 1975. Contract W-31-109-Eng-38. 36p. Dep. NTIS $4.00.

A collocation method for the solution of one-dimensional parabolic partial differential equations using Hermite splines as approximating functions and Gaussian quadrature points as collocation points is described. The method consists of expanding dependent variables in terms of piecewise cubic Hermite splines in the space variable at each time step. The unknown coefficients in the expansion are obtained at every time step by requiring that the resultant differential equation be satisfied at a number of points (in particular, at the Gaussian quadrature points) in the field equal to the number of unknown coefficients. This collocation procedure reduces the partial differential equation to a system of ordinary differential equations which is solved as an initial-value problem using the steady-state solution as the initial condition. The method thus developed is applied to a two-region nonlinear transient heat-conduction problem and compared with a finite-difference method. (4 references) (auth)

25263 (ANL-75-35) ICEPEL, A TWO-DIMENSIONAL COMPUTER PROGRAM FOR THE TRANSIENT ANALYSIS OF A PIPE-ELBOW LOOP. Moneim, M. T. A. (Argonne National Lab., Ill. (USA)). Jul 1975. Contract W-31-109-Eng-38. 57p. AT.

A two-dimensional mathematical model is developed that describes the transient flow in an elbow of any angle and a circular cross section in terms of the r and θ coordinates, and ignores the secondary motion in the elbow. The equations developed are solved numerically using the finite-difference method as applied to the basic Implicit Continuous-Fluid Eulerian technique described by Harlow and Amsden. The method treats the density in the equation of state and the velocities in the equation of mass implicitly. This yielded a set of Poisson's equations in the advanced-time pressures which are solved iteratively. The method also utilizes a time-averaging technique that provides the capability of handling a problem either implicitly or explicitly. A simple example problem of a rigid loop is discussed, and the results are compared with those obtained using the basic ICE method and the one-dimensional water-hammer analysis that utilizes the method of characteristics for the numerical solution. A second example problem of a loop of elastic-plastic pipes and rigid elbows is discussed, and the results are compared with the rigid-loop case. (auth)

25264 (ANL-RDP-41) REACTOR DEVELOPMENT PROGRAM. Progress Report, June 1975. (Argonne National Lab., Ill. (USA)). Jun 1975. Contract W-31-109-Eng-38. 208p. AT.

Progress is reported in the following areas: (1) EBR-2 operations and testing, (2) LMFBR design support, (3) instrumentation and control, (4) fuels and materials development, (5) reactor physics, (6) reactor safety, and (7) GCFR studies. (JWR)

25265 (CONF-750911-2) U. S. ADVANCED MATERIALS DEVELOPMENT PROGRAM FOR STEAM GENERATORS. Patriarca, P.; Harkness, S. D.; Duke, J. M. (Oak Ridge National Lab., Tenn. (USA); Westinghouse Electric Corp., Tampa, Fla. (USA). Tampa Div.). 1975. 32p. Dep. NTIS $4.75.

From international conference on materials for nuclear steam generators; Gatlinburg, Tennessee, USA (9 Sep 1975).

The selection of construction materials for LMFBR steam generators is reviewed, presenting the advantages and limitations of 2¼ Cr-1 Mo steel selected for the Clinch River Breeder Reactor Plant. These limitations indicate that further development of high-strength ferritic steels containing 9 to 12 percent Cr and the high-nickel Alloy 800 could lead to superior materials, and programs to develop these materials have been started. Combustion Engineering has surveyed the experience with the high-strength ferritic steels and prepared ingots of 26 selected compositions. Charpy V-notch tests and metallography have been used to characterize these alloys, and optimum welding rod compositions for these alloys are under development. Westinghouse-Tampa is undertaking a program to gain code acceptance of Alloy 800. A program has been set up to provide the information required for design, justification, and fabrication of reliable components. Progress has been made on characterization, the role of tertiary creep in failure, and the development of welding processes. (auth)

25266 (COO-2426-13) PRELIMINARY ASSESSMENT OF THE IMPACT OF CARBIDE FUELED SUBASSEMBLIES IN THE CRBRP. Vitti, J. A. (ed.). (Combustion Engineering, Inc., Windsor, Conn. (USA)). Aug 1975. Contract AT(11-1)-2426. 124p. (CEND--371). AT.

Although LMFBR design studies with mixed carbide fuel have consistently yielded superior breeding gain, fuel cycle cost, and doubling time performance, the development of mixed carbide fuel has lagged considerably behind that of mixed oxide. Consequently, mixed oxide has been chosen as the reference for CRBRP. An accelerating government supported advanced LMFBR fuels development program, however, is expected to provide sufficient experience with mixed carbide fuel to permit its use sometime during the plant life of the CRBRP. The prime objective of this preliminary study is to examine the impact of inserting carbide subassemblies in place of the reference oxide subassemblies in the CRBRP. (auth)

25267 (ERDA-36) TRIP REPORT: UNITED STATES LMFBR STEAM GENERATOR TEAM. IAEA Symposium, Bensberg, Germany, October 14–17, 1974. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). 1974. 74p. Dep. NTIS $5.45.

Information is presented concerning steam generator design characteristics for the PFR reactor, SNR reactor, PHENIX reactor, SUPER PHENIX reactor, MONJU reactor, and BN-350 reactor; steam generator development programs for West Germany, France, Japan, U. K., and the U.S.S.R.; and the fabrication and inspection of steam generator components. Steam generator performance and maintenance requirements for operating LMFBR reactors are reviewed. (DCC)

25268 (ERDA-46) ADVANCED NUCLEAR REACTORS: AN INTRODUCTION. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Aug 1975. 29p. Dep. NTIS $4.50. GPO $0.65.

An elementary discussion of uranium-fueled reactors is presented, and the role of the LMFBR in the efficient use of fission fuel resources is discussed. (DG)

25269 (EURFNR-1247) PRESENT STATUS AND FURTHER OBJECTIVES OF SNR FUEL ELEMENT DEVELOPMENT. Karsten, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Schneller Brueter). Nov 1974. Translation of KFK-2110. 19p. Dep. NTIS $4.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Within the scope of the fuel element development program for the fast breeder reactor SNR 300, 500 fuel pins have been irradiated since 1964, 250 of them in fast flux. Results indicate that the maximum nominal target burnup of 90,000 MWd/t of the SNR 300 Mk Ia possibly can be reached. The main problems, which arise from clad swelling and internal corrosion, can be met by special pretreatments of the austenitic stainless steel 1.4970 and a fuel stoichiometry of 1.97. Beyond this target burnup either material property improvements have to be made or burnup reductions have to be accepted. The remaining questions can be answered by the use of the SNR 300 as a test reactor. A further target is the development of a carbide fuel element, which should be very effective in a high power breeder reactor because of its low fissile inventory and high breeding gain. This development program will also be finalized in the SNR 300. (auth)

25270 (HEDL-TME-71-179) LMFBR REACTION RATE AND DOSIMETRY. Quarterly Progress Report, September, October, November, 1971. McElroy, W. N. (Comp.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1971. Contract AT(45-1)-2170. 86p. Dep. NTIS $7.50.

The Interlaboratory LMFBR Reaction Rate (ILRR) program has been established by USAEC/RDT to develop a capability to accurately measure neutron-induced reaction rates for LMFBR fuels and materials development programs. The initial goal for the principal fission reactions, ^{235}U, ^{238}U, and ^{239}Pu, is an accuracy to within ±5 at the 95% confidence level. Accurate measurement of other fission and non-fission reactions will be required, but to a lesser accuracy, between ±5 to 10% at the 95% confidence level. A secondary program objective is improvement in knowledge of the nuclear parameters involved in fuels and materials dosimetry measurements of neutron flux, spectra, fluence, and burnup. Progress is reported. Separate abstracts were prepared for four of the sections presented. (WHK)

For abstracts of individual sections see: 24362, 24363, 25110, and 25298.

25271 (HEDL-TME-75-75) CONCRETE PROTECTION FROM SODIUM SPILLS BY INTENTIONALLY DEFECTED LINERS, SMALL-SCALE TESTS S9 AND S10. Hilliard, R. K.; Boehmer, W. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1975. Contract AT(45-1)-2170. 41p. Dep. NTIS $4.00.

Two small scale tests were performed to determine the protection against sodium attack afforded to a concrete surface by a defected steel liner. An inert atmosphere was maintained over the sodium pool, which was heated electrically to 1600°F for 2–6 hrs in one test, to 1380°F for 19 hrs in the other. The 10 inch diameter vertical concrete surface was separated from the sodium by a liner plate in which small defects had been drilled. The plates provided significant protection against direct chemical attack, but most of the water was released from the concrete through the defects to react in the sodium pool region. The liners were corroded significantly in the defect areas. (auth)

25272 (IFA-RT-3-1974) POWER-FAST-REACTOR OPTIMIZATION BY THE GAME THEORY. Pavelescu, M.; Dumitrescu, H.; Adam, S. (Institutul de Fizica Atomica, Bucharest (Romania)). 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

In the first stage of the use of the fast breeder reactor, as the fissile-material amounts are small, interest is in fast breeder reactors which achieve maximum power at the expense of minimum fissile-material mass. This problem shows a two-matrix-game structure. A competitive-game solution and a cooperative-game solution are determined to optimize the distribution of the fissile and fertile materials in the multizone fast reactors. Another optimization problem which is solved is that of finding the reactor structure for which the power nonuniformity factor and the flux nonuniformity factor are minimum. This is, also, a mathematical two-matrix game and it is solved as above. (11 references) (auth)

25273 (KFK-2134) UO_2-PuO_2 FUEL PIN CAPSULE-IRRADIATIONS OF THE TEST SERIES FR 2-5a. Evaluation of post-irradiation examination results. Dienst, W.; Goetzmann, O.; Schulz, B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Jun 1975. 46p. (In German). Dep. NTIS (US Sales Only) $5.50.

In the capsule-irradiation test series FR 2-5a, short UO_2-PuO_2 fuel pins (80 mm fuel length) of 7 mm diameter were irradiated in a thermal neutron flux at mean rod powers of 400 - 450 W/cm and mean cladding surface temperatures of 500 - 550°C to burnups of 0.6, 1.8 and 5.0 at % (U+Pu). The test series was to compare the influence of the fuel density for fuel column sections of different sintered density. Therefore, the fuel columns were subdivided into four density steps each of about 84, 87, 90 and 93% TD. Void volume redistribution in the fuel pins was examined in micrographs of cross-sections by measuring crack widths, central void diameters, and fuel porosity. Results are presented. (auth)

25274 (ORNL-TM-4886) ANALYSIS OF FAILED CATEGORY II ELECTRIC HEATERS THAT SIMULATE LMFBR FUEL PINS. Martin, M. M.; Clark, D. L. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 54p. AT.

Examination of prematurely failed high-performance electrical heaters, which simulate LMFBR fuel pins, revealed that all had been damaged similarly during operational testing. Failure culminated in severance of their heating elements and, in most instances, penetration of their type 316 stainless steel sheaths. All contained indications of incipient failure in that their heating elements of KANTHAL A-1 alloy had partially melted at numerous locations. A mechanism for the generation of internal nitrogen pressure from the boron nitride insulation on molten heating elements was suggested. The principal reason for incipient failure was inadequate transfer of heat from the heating element into the surrounding boron nitride insulation. Adverse preferred orientation and numerous low-density regions reduced the effective thermal properties of the boron nitride insulation and thereby contributed to failure of the heaters. (auth)

25275 (PMC-75-02) CLINCH RIVER BREEDER REACTOR PROJECT: A BRIEFING FOR ENGINEERS. Proceedings of the Breeder Reactor Corporation April 1975 Information Session, Los Angeles, California. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). 1975. 97p. (CONF-750478-). AT.

Topics discussed include management organization and planning, LMFBR economics, site studies, balance-of-plant design, buildings, and steam generators. (DG)

25276 USE OF THE ML-1 LOOP IN NOISE ANALYSIS EXPERIMENTS. Perez-Navarro, A. (Junta de Energia Nuclear, Madrid); Zurro, B.; Verdague F.; Melches, I.; Benkert, J.; Mika, C.; Raes, K. H.; Stegemann, D. Energ. Nucl. (Madrid); 19: No. 95, 201-207(1975). (In Spanish).

The possibilities of using the ML-1 loop within a program for the analysis of temperature fluctuation noise in order to develop a diagnostic technique for damage to the coolant system are discussed. The elements used for the determination of the heat transfer rates and characteristics, using the techniques cited for noise analysis, are described. Results are reported. (tr-auth)

25277 EXPERIMENTAL CORROSION PROGRAM IN THE ML-1. Marin, A. (Junta de Energia Nuclear, Madrid); Solano, R.; Borgstedt, H. Energ. Nucl. (Madrid); 19: No. 95, 191-200 (1975). (In Spanish).

The results obtained in the initial corrosion tests showed not only that the operation of the ML-1 loop was satisfactory but that the corrosion of the steel samples was comparable to that obtained in the Karlsruhe high temperature loop. The downstream effect on cladding materials tested at 700°C was noticeable. (tr-auth)

25278 ELECTRIC AND CONTROL INSTALLATIONS OF THE ML-1 SODIUM LOOP. Faure, R.; Galindo, F.; Vallejo, M. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 19: No. 95, 181-190(1975). (In Spanish).

The electrical circuits and control instrumentation in the ML-1 loop are described. The electrical heating system and the temperature control system using about 100 thermocouples are analyzed. The electromagnetic pumps which circulate the liquid sodium and the electrical supply of the ventilation system of the loop are studied. The instrumentation which exhibits novel characteristics because of the special properties of the liquid sodium is described in detail. (tr-auth)

25279 START-UP AND OPERATING EXPERIENCE WITH THE ML-1 SODIUM LOOP. De la Torre, M.; Martinez Domenech, F. J.; Garcia, M. V.; De Celis, B. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 19: No. 95, 171-180(1975). (In Spanish).

The general results obtained in the initial phases of operation of the ML-1 loop with respect to the development of a sodium technology are summarized. The operating methods used in the tests and in normal operation are described. The results obtained with the sodium purification system and the system for control of impurities in sodium are reported. The future experimentation program is outlined. (tr-auth)

25280 GENERAL DESCRIPTION OF THE ML-1 LOOP. Oltra, F. (Junta de Energia Nuclear, Madrid); Bojarsky, E.; Leising, H. Energ. Nucl. (Madrid); 19: No. 95, 161-169(1975). (In Spanish).

The ML-1 loop is an installation for handling liquid Na up to a temperature of 750°C. The versatility of this installation makes it possible to carry out different types of tests simultaneously, such as corrosion tests, component testing, and instrument testing. In the construction, assembly, and use of this loop there was international cooperation. The installation has been in operation since July 1973 with more than 3,000 hrs of operation. (tr-auth)

25281 LIQUID SODIUM AS A REACTOR COOLANT. Tanarro Sanz, A. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 19: No. 95, 149-160(1975). (In Spanish).

The most desirable general characteristics in reactor coolants are described and the possibilities of using liquid Na for this purpose are analyzed. The results of the analysis shows the utility of liquid Na in the first generation of fast breeders and the necessity of mastering the technological problems associated with its use. Experimental Na loops provided with special instrumentation are used for these studies. The basic principles of these loops are described. (tr-auth)

25282 ORIFICE DESIGN FOR THE CONTROL OF COUPLED REGION FLOW. Atherton, R.; Spadaro, P. R.; Brummerhop, F. G. (to U. S. Energy Research and Development Administration). US Patent 3,878,870,. F15d1/10. 22 Apr 1975. Filed Date 16 Apr 1974. 20p.

PAT-APPL-461,316.

A fluid system arrangement for nuclear reactors is described comprising a triplate orifice apparatus which simultaneously controls core flow distribution, flow rate ratio between hydraulically coupled regions of the blanket and radial static pressure gradients entering and leaving the blanket fuel region. The design of the apparatus is based on the parameters of the diameter of the orifice holes, the friction factor, and expansion, contraction and turning pressure loss coefficients of the geometry of each orifice region. These above parameters are properly matched to provide the desired pressure drop, flow split and negligible cross flow at the interface of standard and power-flattened open lattice blanket regions. (Official Gazette)

25283 METHOD OF DETECTING A FUEL ELEMENT FAILURE. Cohen, P. (to U. S. Energy Research and Development

Administration). US Patent 3,881,989. G21c17/04. 6 May 1975. Filed date 23 Jul 1973. 9p.

PAT-APPL-381,633.

A method is described for detecting a fuel element failure in a liquid-sodium-cooled fast breeder reactor consisting of equilibrating a sample of the coolant with a molten salt consisting of a mixture of barium iodide and strontium iodide (or other iodides) whereby a large fraction of any radioactive iodine present in the liquid sodium coolant exchanges with the iodine present in the salt; separating the molten salt and sodium; if necessary, equilibrating the molten salt with nonradioactive sodium and separating the molten salt and sodium; and monitoring the molten salt for the presence of iodine, the presence of iodine indicating that the cladding of a fuel element has failed. (Official Gazette)

25284 MODULAR CORE COMPONENT SUPPORT FOR NUCLEAR REACTOR. Finch, L. M.; Anthony, A. J. (to U. S. Energy Research and Development Administration). US Patent 3,888,731. G21c15/00. 10 Jun 1975. Filed date 15 Mar 1973. 10p.

PAT-APPL-341,612.

The core of a nuclear reactor is made up of a plurality of support modules for containing components such as fuel elements, reflectors and control rods. Each module includes a component support portion located above a grid plate in a low-pressure coolant zone and a coolant inlet portion disposed within a module receptacle which depends from the grid plate into a zone of high-pressure coolant. Coolant enters the module through aligned openings within the receptacle and module inlet portion and flows upward into contact with the core components. The modules are hydraulically balanced within the receptacles to prevent expulsion by the upward coolant forces. (Official Gazette)

25285 FLUIDIZED-BED NUCLEAR REACTOR. Grimmett, E. S.; Kunze, J. F. (to U. S. Energy Research and Development Administration). US Patent 3,888,733. G21c3/44. 10 June 1975. Filed date 21 Dec 1973. 12p.

PAT-APPL-427,391.

A reactor vessel containing a fluidized-bed region of particulate material including both a neutron-moderating and a fertile substance is described. A gas flow including fissile material passes through the vessel at a sufficient rate to fluidize the particulate material and at a sufficient density to support a thermal fission reaction within the fluidized-bed region. The high-temperature portion of a heat transfer system is located within the fluidized-bed region of the reactor vessel in direct contact with the fluidized particles. Heat released by fission is thereby transferred at an enhanced rate to a coolant circulating within the heat transfer system. Fission products are continuously removed from the gas flow and supplemental fissile material added during the reactor operation. (Official Gazette)

25286 THERMAL RATCHETTING IN PIPES SUBJECTED TO INTERMITTENT THERMAL DOWNSHOCKS AT ELEVATED TEMPERATURES. Corum, J. M.; Young, H. C.; Grindell, A. G. (Oak Ridge National Lab., TN). pp 47-58 of Pressure Vessels and Piping: Verification and Qualification of Inelastic Analysis Computer Programs. Corum, J. M.; Wright, W. B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-16.

Many of the structural design problems requiring inelastic analyses in high-temperature, liquid-metal-cooled reactor system components result from the frequent thermal transients that can occur. These transients can, if sufficiently severe, produce progressive inelastic deformations (ratchetting). The results of two thermal ratchetting tests on straight sections of pipe are presented. The pipes, each of which was machined from a well-characterized heat of Type 304 stainless steel, were subjected to a series of thermal downshocks on their inner surface, followed by sustained periods under an internal pressure loading at a temperature of 1100°F. Testing was carried out in a special sodium test facility built for the purpose, and the outer surface strain histories were measured using high-temperature capacitive strain gages. The circumferential strain responses, which typify the inelastic behaviors, are presented. (auth)

25287 TIME STEP ESTIMATION IN THE NUMERICAL ANALYSIS OF CREEP PROBLEMS INVOLVING SECONDARY STRESS RELAXATION. Vaidyanathan, S.; Turner, J. E. (General Electric Co., Sunnyvale, CA). pp 53-61 of Fuel Element Analysis. Rashid, Y. R. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-17.

In the numerical analysis of creep problems involving varying temperature gradients, small time steps have to be prescribed to follow the relaxation of the thermal stresses. In particular, for problems involving very high creep rates such as those encountered in fuel modeling, divergence could result in a non-iterative, direct solution technique if the time steps are not chosen in a consistent manner. An approximation is given for the relaxation of thermal stresses in a pressurized tubular structure with a temperature gradient across the thickness which has been found to describe closely the actual relaxation behavior. The approximation can be used to estimate the time steps necessary in the numerical solution procedure. The validity of this estimation procedure is illustrated with application to the method of successive elastic solutions. (auth)

25288 RELIABILITY EVALUATION OF A SODIUM HEATED STEAM GENERATOR. Gangadharan, A. C.; Gupta, G. D.; Berman, I. (Foster Wheeler Energy Corp., Livingston, NJ). pp 51-68 of Reliability Engineering in Pressure Vessels and Piping. Gangadharan, A. C. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-18.

A description is given of the application of failure mode and effects analysis for reliability evaluation of a sodium heated steam generator design which was proposed for the Clinch River Breeder Reactor Project. The basic ideas involved in reliability, maintainability, and safety analysis are briefly reviewed. The methods available to conduct such studies are outlined. The impact of coordinating reliability studies with other facets of a design process is emphasized. (auth)

25289 REMOVABLE DIAGRID FOR SUPPORTING THE FUEL ASSEMBLIES OF A NUCLEAR REACTOR. Aubert, Michel; Bellier, M.; Berniolles, J. M. (to Commissariat a l'Energie Atomique). US Patent 3,893,886. 8 Jul 1975. Priority date 20 Jan 1972, France. 6p.

A removable diagrid is described for supporting fuel assemblies in sodium-cooled fast reactors. It consists of a single-unit assembly which is laid on an internal annular shoulder formed in the lateral cylindrical shell of a vertical reactor tank. The single-unit assembly comprises two parallel and horizontal support plates which are rigidly fixed to an annular distribution box element and braced by vertical hollow columns in which the lower ends of the fuel assemblies to be supported are engaged, a toric manifold for a coolant fluid at high pressure, and vertical ducts which open at one end into the manifold and at the other end into the annular box element. (Official Gazette)

25290 NUCLEAR REACTORS. Jackson, G. O. (to United Kingdom Atomic Energy Authority). US Patent 3,888,730. 10 Jun 1975. Priority date 23 Feb 1968, United Kingdom of Great Britain and Northern Ireland. 4p.

In a liquid cooled nuclear reactor, the combination is described for a single-walled vessel containing liquid coolant in which the reactor core is submerged, and a containment structure, primarily of material for shielding against radioactivity, surrounding at least the liquid-containing part of the vessel with clearance therebetween and having that surface thereof which faces the vessel make compatible with the liquid, thereby providing a leak jacket for the vessel. The structure is preferably a metal-lined concrete vault, and cooling means are provided for protecting the concrete against reaching a temperature at which damage would occur. (Official Gazette)

25291 VENTED NUCLEAR FUEL ELEMENT. Hirose, Y. (to Hitachi, Ltd.). US Patent 3,892,626. 1 Jul 1975. Priority date 12 Dec 1970, Japan. 6p.

An improvement is described for a vented nuclear fuel element which discharges gaseous fission products generated in the fuel element into coolant. It comprises a gas check valve including a gas permeable porous disk and such material that liquefies at operation temperature of a nuclear reactor. The porous disk and the material are disposed in combination in a gas venting path. The gaseous fission products are vented through the valve, and during shutdown the material solidifies to seal the fuel element from venting the gaseous fission products. (Official Gazette)

25292 LIQUID METAL STEAM GENERATOR. Wolowodiuk, W. (to Foster Wheeler Corp.). US Patent 3,888,212. 10 Jun 1975. Filed date 24 Oct 1972. 4p.

A liquid metal heated steam generator is described which in the event of a tube failure quickly exhausts out of the steam generator the products of the reaction between the water and the liquid metal. The steam is generated in a plurality of bayonet tubes which are heated by liquid metal flowing over them between an inner cylinder and an outer cylinder. The inner cylinder extends above the level of liquid metal but below the main tube sheet. A central pipe extends down into the inner cylinder with a centrifugal separator between it and the inner cylinder at its lower end and an involute deflector

plate above the separator so that the products of a reaction between the liquid metal and the water will be deflected downwardly by the deflector plate and through the separator so that the liquid metal will flow outwardly and away from the central pipe through which the steam and gaseous reaction products are exhausted. (Official Gazette)

25293 FLOW-THROTTLING ORIFICE NOZZLE. Sletten, H. L. (to Rockwell International Corp.). US Patent 3,873,419. 25 Mar 1975. Filed date 3 Jul 1972. 8p.

A series-parallel-flow type throttling apparatus to restrict coolant flow to certain fuel assemblies of a nuclear reactor is comprised of an axial extension nozzle of the fuel assembly. The nozzle has a series of concentric tubes with parallel-flow orifice holes in each tube. Flow passes from a high pressure plenum chamber outside the nozzle through the holes in each tube in series to the inside of the innermost tube where the coolant, having dissipated most of its pressure, flows axially to the fuel element. (Official Gazette)

25294 GAS ENTRAINMENT AT THE FREE SURFACE OF A LIQUID: ENTRAINMENT INCEPTION AT A VORTEX WITH AN UNSTABLE GAS CORE. Baum, M. R.; Cook, M. E. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nucl. Eng. Des.; 32: No. 2, 239-245(1975).

Experiments have been performed using sodium, water, white spirit and Freon 113 in a simple small-scale system to determine the conditions necessary for gas entrainment inception at a vortex with an unstable gas core. The results demonstrate that surface tension effects play a major role and hence they must not be ignored when developing an entrainment-free system. (auth)

25295 TRANSPORT MODEL FOR RADIOACTIVE CORROSION PRODUCT DEPOSITION IN AN LMFBR. Cooper, M. H.; Taylor, G. R. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Nucl. Eng. Des.; 32: No. 2, 246-251(1975).

Distribution of radioactive corrosion products, cobalt-58, cobalt-60, and manganese-54, from the core of a liquid-metal fast breeder reactor (LMFBR) is analytically modeled using a mass-transfer controlled deposition process. "Sticking coefficients", which are experimentally determined from corrosion testing of irradiated stainless steel specimens, modify the mass transfer coefficient to account for the nuclides transported to a surface which do not adhere or are subsequently re-dissolved. Corrosion product activities on the surfaces of primary system components of a typical LMFBR are calculated both with and without surface traps consisting of knitted stainless steel wire or corrugated stainless steel foil. (auth)

Research, Test, and Experimental Reactors

Refer also to abstracts 24362, 24363, 25264, 25270, 25366, 25386, 25434, and 25472.

25296 (ANL-CT-75-36) ANALYTICAL AND EXPERIMENTAL STUDY OF TWO CONCENTRIC CYLINDERS COUPLED BY A FLUID GAP. Mulcahy, T. M.; Turula, P.; Chung, H.; Jendrzejczyk, J. A. (Argonne National Lab., Ill. (USA)). Apr 1975. 17p. (CONF-750908-3). Dep. NTIS $4.00.

From 3rd international conference on structural mechanics in reactor technology; London, UK (1 Sep 1975).

A breeder reactor vessel is a substantial steel cylinder which is partially protected from the nuclear reaction temperature by a relatively thin concentric shell separated from the vessel by a narrow fluid-filled gap. An experimental and analytical study of the vibration of a model of such a shell used in the Fast Test Reactor is described. The analytical work consists first using a free vibration solution of the shell in vacuum as a basis for extrapolating vibration behavior for the same shell with a fluid gap. Then a direct finite element solution is found for the actual problem--the shell and the fluid coupling it to the rigid outer container. All the finite element computations were carried out using the NASTRAN program. The experimental setup consisted of a steel sheet rolled and welded into a cylinder, free at the top edge and at the bottom soldered to a disc which in turn was bolted to a heavy base plate. The fluid gap was provided by using a thick concrete shell as the outer cylinder. A series of these cylinders was used to provide several sizes of annular gap. The case of the steel shell alone, without fluid, was also considered. The steel cylinder was vibrated by an electromagnetic exciter using both harmonic loading and random loading functions. In general, correspondence of experimental and analytical results is within acceptable limits; however, several vibration modes corresponding to solutions with low circumferential wave numbers were not detected experimentally. Response analysis performed to compare the response amplitude at various modes indicates that the intensity at the modes in question is very low. (auth)

25297 (HEDL-SA-934) FFTF: ROSETTA STONE OF THE U. S. BREEDER REACTOR PROGRAM. McGough, C. B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 17 Apr 1975. 44p. (CONF-750464-1). Dep. NTIS $5.25.

From joint meeting of ASME and AIEEE Hawaii sections; Honolulu, Hawaii, USA (17 Apr 1975).

Design specifications for FFTF components are presented. Reactor operating parameters are included. 9 references. (DCC)

25298 (HEDL-TME-71-179, pp HEDL.10-HEDL.16) CFRMF REACTION RATES BY RADIOCHEMISTRY. McElroy, W. N.; Kellogg, L. S.; Matsumoto, W. Y. Dec 1971.

In LMFBR reaction rate and dosimetry. Quarterly progress report, September, October, November, 1971. (Hanford Engineering Development Lab., Richland, Wash. (USA)).

A preliminary CFRMF test was scheduled to check out suggested power normalization procedures and the counting of ^{140}Ba–^{140}La for fission foils. The use of a revised set of fission yields for determining fission rates for ^{235}U, ^{238}U, ^{237}Np, and ^{239}Pu is suggested for the CFRMF test and routine EBR-II dosimetry. Construction was started at NBS of two duplicate NBS fission chambers for use in all activation, track etch, and helium mass spectrometric measurements to provide further assurance that all detection techniques will be measuring the same incident flux. (auth)

25299 (HEDL-TME-75-52) CENTRAL FUEL WORTH IN THE FAST TEST REACTOR (FTR) ENGINEERING MOCKUP. Dobbin, K. D.; Daughtry, J. W. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1975. Contract AT(45-1)-2170. 27p. AT.

The reactivity change associated with the movement of fuel along the axial centerline of the FTR engineering mockup was computed. A detailed three-dimensional model using the diffusion theory code, 3DB, was used to compute the total reactivity worth, and a two-dimensional R-Z model using the diffusion theory code, 2DB, was used to compute the axial worth profile. Twelve energy groups were used in both sets of calculations. Comparison of the results with experimental data provided calculation to experiment (C/E) bias factors which can be applied to the calculation of the central fuel worth in the FTR. 13 references. (auth)

25300 (HEDL-TME-75-79) METHOD FOR DETERMINING DETAILED ROD WORTH PROFILES AT LOW POWER IN THE FAST TEST REACTOR. Sevenich, R. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1975. Contract AT(45-1)-2170. 51p. Dep. NTIS $5.75.

A method for obtaining a detailed rod worth profile at low power for a slow control rod insertion is presented. The accuracy of the method depends on a preparatory experiment in which the test rod is dropped quickly to yield, upon analysis, the magnitude of the rod worth and an effective source value. These numbers are employed to initialize the inverse kinetics analysis for the slow insertion. Corrections for changes in detection efficiency are not included for the simulated experiments. (auth)

25301 (LA-5963) REFLECTOR-MODERATED CRITICAL ASSEMBLIES. Paxton, H. C.; Jarvis, G. A.; Byers, C. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1975. Contract W-7405-ENG-36. 11p. Dep. NTIS $4.00.

Experiments with reflector-moderated critical assemblies were part of the Rover Program at the Los Alamos Scientific Laboratory (LASL). These assemblies were characterized by thick D_2O or beryllium reflectors surrounding large cavities that contained highly enriched uranium at low average densities. Because interest in this type of system has been revived by LASL Plasma Cavity Assembly studies, more detailed descriptions of the early assemblies than had been available in the unclassified literature are provided. (auth)

25302 (ORNL-TM-4283) ORNL TSF PIPE CHASE NEUTRON STREAMING EXPERIMENT, PHASE 2. McGregor, B. J.; Clifford, C. E.; Muckenthaler, F. J.; Mynatt, F. R. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 51p. AT.

A second ORNL Tower Shielding Facility experiment has been performed and analyzed in the investigation of techniques for predicting the extent of neutron streaming through the sodium coolant pipes of the Fast Flux Test Facility (FFTF). In this second experiment the HTS pipeway of the FFTF was mocked up by a concrete-walled plenum (18 ft by 13.7 ft by 57.5 in.) lined with steel. A beam of reactor neutrons entered through one of the large walls and scattered throughout the plenum. A fraction of

the scattered neutrons then entered a 31-in.-diam pipe-chase mockup located near one end of the plenum in the large wall on which the beam was incident. Measurements of neutron intensities were made with Bonner ball detectors along horizontal and vertical traverses within the plenum, and neutron spectra were measured with a Benjamin spectrometer at two locations within the plenum. Bonner ball measurements were also made along the axis of the empty pipe chase and along radial traverses beyond the empty pipe chase outside the plenum. Additional measurements were made beyond the pipe chase containing first a 16-in.-OD sodium-filled pipe and then the pipe surrounded by insulation. 9 references. (auth)

25303 (SURRC-52/75) REPORT ON SESSION 1973–1974. Wilson, H. W. (See CODE-5681300 Scottish Research Reactor Centre, East Kilbride (UK)). 1974. 41p. Dep. NTIS (US Sales Only) $5.25.

Information is presented concerning reactor operation and development; beam tubes and irradiation facilities; cobalt irradiation rig; physics studies; radiochemistry; health physics and nuclear medicine; isotope geology; radiocarbon laboratory; and electronics developments. (DCC)

25304 EXPERIENCE IN CREATION AND PERSPECTIVES OF USE OF NEUTRON MEDICO-BIOLOGICAL BEAM. Zherbin, E. A.; Ivanov, V. N.; Luchnik, N. V.; Efimov, I. A.; Zeinalov, E. I.; Obaturov, G. M.; Shalin, V. A. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 20: No. 7, 52-59(Jul 1975). (In Russian).

A neutron medico-biological beam was produced on the research reactor BR-10 with the rated power of 10 MW for conducting radiological and therapeutic investigations. The physical characteristics are presented of horizontal beams of fast and intermediate neutrons from the channels B-3 and P-2 of the BR-10 reactor, which have a diameter of 50 mm (neutron spectra, fluxes, and tissue kerma of neutrons in different energy ranges). Mean energies of the neutrons equal 0.85 MeV for the B-3 beam and 0.35 for the P-2 beam. The neutron-current density in these beams (the reactor power being 1 MW) is correspondingly $1.5 \cdot 10^9$ and 1.47×10^8 neutr/cm^2 per one second. The power of the tissue kerma is 128 and 7.8 rad/min. The contribution of gamma radiation does not exceed 4 per cent of the whole dose. The perspectives for use of the BR-10 reactor channels for medico-biological investigations are discussed. (auth)

25305 INVESTIGATION OF EFFECTIVE NEUTRON TEMPERATURES IN REACTOR CORE WITH LUTETIUM AS A SPECTRAL INDEX DETECTOR. Yang, H. Y.; Chen, S. L. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Nucl. Sci. J. (Taiwan); 12: No. 2, 69-75(Jun 1975).

The effective neutron temperature of the zero power reactor Lung-tan was measured using lutetium as a spectral index detector. Neutron temperatures were inferred from the ratio of ^{77}Lu to ^{176m}Lu. A discussion of the ratios obtained in various assemblies which were placed in the center of a graphite thermal column is presented. The data obtained in the case of the graphite assembly are used as a calibration of the neutron temperature. The results show that the effective neutron temperatures are 267 ± 4°C at positions near the control rods and 204 ± 4°C at the center of the core while the reactor is operating at 10 KW. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 24268, 24269, and 25367.

25306 BLOWDOWN EFFECTS ON A FUEL ROD. Kendall, J. M. (Electric Power Research Inst., Palo Alto, CA). Hsu, M. B.; Chan, C.; Dwyer, T. J. pp 37-51 of Fuel Element Analysis, Rashid, Y. R. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-17.

During the initial depressurization phase of a hypothetical loss of coolant incident in a pressurized water reactor, the fuel rods will be subjected to large, rapid changes in operating conditions which may affect the configuration of the rods. Since power operating conditions of a fuel rod are a function of operating history as well as position within the core, a wide variety of initial operating conditions must be considered in an evaluation of the consequences of a postulated incident. A description is given of a study to investigate the feasibility of using existing thermal and structural analysis codes to perform a coupled thermal and stress analysis of transient fuel rod response under hypothetical loss of coolant accident conditions. A coupled thermal-stress finite element analysis procedure was established. Both one-dimensional and three-dimensional models were investigated. The effect of two gap conditions and two initial stress states on the response of the fuel rod was studied. Finite element analysis results of the fuel rod are presented. (auth)

Propulsion and Package Reactors

Refer also to abstracts 24432, 25387–25390, and 25473–25476.

25307 (AGC-2323 (Vol.2)) NERVA ENGINE DEVELOPMENT PROGRAM AND ASSOCIATED TASKS, CONTRACT YEAR 1962. Summary Report. Volume II. (Aerojet-General Corp., Azusa, Calif. (USA)). Nov 1962. 285p. Dep. NTIS $17.25.

Declassified 11 Sep 1973.

Programs in NERVA engine support systems are outlined: Remote handling equipment, ground support equipment (checkout, test, handling and maintenance systems), diagnostic instrumentation, field support, reliability, safety, training and assistance to LASL. NRDS support is discussed as follows: Master plan, engine test stand No. 1, engine test stand No. 2, E-MAD building, data acquisition systems and a radiation effects facility. Management policy is described: PERT, fiscal control, documentation and a central data system. Finally, several test facilities and test equipment items are described. (LTN)

25308 (GTM-76) MARITIME GAS COOLED REACTOR PROJECT. Metallurgical Program Progress Report, September 1, 1959. Wall, F. J. (Westinghouse Electric Corp., Lester, Pa. (USA). Steam Div.). 30 Nov 1959. Contract AT(04-3)-187. 59p. Dep. NTIS $6.00.

For General Dynamics Corp., Groton, Conn.

The metallurgical evaluation program, as it applies to the turbo-machinery for the Maritime Gas Cooled Reactor Project, has progressed from one of a few exploratory tests to one of many tests involving numerous elevated temperature characteristics of materials. In addition, each test is of an intricate nature and the entire program has become correspondingly complex. Therefore, it is expedient to review the program from an historical point of view starting from the time little was known about the properties of commercial alloys in controlled atmospheres to the present time where a considerable amount of experience has been gained. Thus, the review of the MGCR metallurgical program is divided into two phases as each is a program in itself. Results of tests completed to date and hypotheses involving the mechanism of behavior of metals in helium at elevated temperatures and stresses are presented. Some conclusions are presented. Recommendations concerning the overall program are included for consideration in the continuing test program. (auth)

25309 (NTO-R-0018) NRX-A2 POST TEST REPORT. (NERVA Test Operations, Mercury, Nev. (USA)). 5 Feb 1965. 221p. Dep. NTIS $14.25.

Declassified 10 Sep 1973.

The NRX-A2 disassembly operation was performed at the R-MAD Facility at NRDS. The results noted during the post-test operations have assured the ability of the Test Assembly to operate at conditions up to design point power and have provided valuable data applicable to the design of future NRX Reactors. No damage related to power testing was apparent in the non-nuclear hardware, the core support assembly, the cluster hardware or the outer reflector assembly. The fuel region components sustained minor damage. Some elements were eroded and in-core instrumentation was affected by erosion at thermocouple graphite potted interfaces. The test car and related systems and components showed no damage. To date, 90% of all post-test inspections have been successfully performed as planned or approved by the Test Specification and Procedure Review Board and all post-test objectives are being satisfied. (auth)

25310 (PWA-2224 (Vol.2)) DESIGN REPORT: ADVANCED NUCLEAR-ELECTRIC POWER GENERATOR SYSTEM STUDY. Thermionic Nuclear Space Powerplant. Volume II. (Pratt and Whitney Aircraft, East Hartford, Conn. (USA)). 5 Sep 1963. 319p. Dep. NTIS $19.00.

Declassified 31 Aug 1973.

A discussion is presented of a structural analysis of the thermionic reactor fuel element. The analysis was performed for design point operation. The converter components analyzed include the cathode, cathode support structure, electrical insulator, and trilayer. Several geometries, material combinations, and fabrication methods were considered. The analysis undertaken has indicated the critical need for good data on the mechanical properties of refractory metals and ceramics. (auth)

25311 (RP-SR-0001 (Vol.1)) PHOEBUS-2 NOZZLE DESIGN PROGRAM PRELIMINARY DESIGN PHASE, SUMMARY REPORT. Volume I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1965. 429p. Dep. NTIS $24.50.

Declassified 10 Sep 1973.

The results of the work performed under the study phase of the Phoebus-2 nozzle contract are summarized. The final design of the special test equipment and the initial phases of the heat transfer experimental program for the liquid and gas side heat transfer coefficients are described. Also, based on the findings of the study phase, recommendations are made for further development work. The nozzle design concept selected for study was the U-tube nozzle constructed of Hastelloy-X. The study program utilized a great deal of pertinent experience gained on the NERVA program. As a result of the preliminary design studies conducted, it is concluded that the design concept for the Phoebus-2 nozzle based on the U-tube is sound and it is recommended that the final design proceed based on this concept. It is further concluded that potential major problem areas can be categorized as follows: High heat flux at throat of nozzle; hastelloy-X jacket welding; first development nozzle fabrication completion date; and high heat flux at entrance to adapter. Recommendations of how to avoid program delays due to these potential problems are discussed. (auth)

25312 (TID/SNA-1912) NOTES ON PHILCO–FORD INTREMOLD DATA. (Aerojet-General Corp., Sacramento, Calif. (USA)). 9 Dec 1971. 132p. Dep. NTIS $9.75.

A work book and notes on pyrolyzed and graphitized plastics has been documented. In many of the experiments the material was reimpregnated at high pressure and reprocessed several times to get higher density and better mechanical properties. Data on similar products (such as Union Carbides thornel) are included. (LTN)

25313 (TID/SNA-2092) DEVELOPMENT TEST REPORT OF KIWI-B AND HYBRID NOZZLES. (Aerojet-General Corp., Sacramento, Calif. (USA)). 22 Mar 1963. 105p. Dep. NTIS $8.25.

Declassified 10 Sep 1973.

During the hydrostatic test of the KIWI-B nozzle, S/N 002K, the aluminum jacket failed after holding 800 psig for 3 minutes. Two longitudinal splits 180° apart occurred, extending through the complete length of the jacket from the torus to the pressure vessel mounting flange, and coincided with the positions of two of the four vertical in-gates of the casting mold. The post-failure metallurgical investigation established that general gas porosity prevailed throughout the cast jacket. The failure originated just below the pressure vessel mounting flange where spongy material was predominant due to shrinkage. In the area of the origin of failure, where shrinkage was predominant, the ultimate tensile strength was as low as 1.6 ksi. The elongation in the non-fractured areas ranged from 1% to 4%, predominately 2%. The fractured zone exhibited 0.16% elongation and zero elongation was established for the failure origin zone. The chemical composition of the A356 alloy was found to conform with the specification. The defective areas were of needle-like eutectic structure and contained considerable coarseness, thus contributing to low ductility and lack of strength as well. The failure of the shear lip of Hybrid nozzle S/N 001H occurred during the Nerwi Hydrostatic Test. Subsequent chemical, metallurgical, and stress investigations indicate that poor casting quality in the region of the shear lip resulted in reduced tensile strength and failure at stress levels lower than expected. (auth)

25314 (TID/SNA-3010) TCD 9660-004 HYBRID NOZZLE TEST PLAN. Wright, R. B. (Aerojet Liquid Rocket Co., Sacramento, Calif. (USA)). 30 Mar 1964. 20p. Dep. NTIS $4.00.

Declassified 12 Sep 1973.

Detailed plans for testing two prototype NERVA nozzles are developed, using LO_2/LH_2 with modified Titan injectors to simulate nuclear reactor flow rate, temperature and pressure. (LTN)

25315 (WANL-PR(J)-040) NERVA NUCLEAR SUBSYSTEM. Progress Report, 1 October 1965–31 December 1965. Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Jan 1966. 185p. Dep. NTIS $12.25.

Declassified 11 Sep 1973.

The major activity consisted of preparations for the start of tests of the NRX/EST at the Test Cell "A" facility of the Nuclear Reactor Development Station, Jackass Flats, Nevada. During the first experimental plan EP-1A on 8 December 1965 step and frequency response measurements of the nuclear power control loop were made. The data, when reduced, showed excellent agreement between measured results. Experimental Plan 1A Prime was performed on 15 December 1965. The particular requirements of the NRX/EST Test Specification, NJD-2, as pertains to the checkout of the PCV-41 Pressure Control Loop were satisfied. Significant achievements included frequency response measurements on the PCV-41 Pressure Controller and the performance of four cold flow tests. The PCV-41 Pressure Control Loop proved to be stable and the checkout was satisfactory. Control drum behavior and system pressure observed during the ambient hydrogen gas runs were as predicted. The four cold flow tests were not successful in that the turbine failed to rotate as predicted. Post-test examination of the turbine exhaust lines showed evidence of overheating. It was concluded that hydrogen burning had occurred intermittently in one or the other of the turbine exhaust stacks. Finally, the NRX/EST test assembly successfully passed a zero reactor power cold-flow bootstrap test. The results were very close to the test predictions based on CFDTS data. Component parts and fuel were being readied for assembly into the NRX-A5. The NERVA II design evaluation continued. (auth)

25316 (WANL-PR(J)-052) NERVA NUCLEAR SUBSYSTEM. Progress Report, 1 October 1968–31 December 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Jan 1969. 153p. Dep. NTIS $10.75.

Declassified 11 Sep 1973.

The joint NERVA system shielding study conducted by AGC and WANL was completed and presented to SNPO in October. This required extensive analysis and coordination over an extended interval of time. It resulted in a decision by SNPO in November to provide shielding flexibility internal and external to the reactor pressure vessel because of the mission spectrum to be satisfied, established a weight goal, and initiated another study to further converge the solution. A comprehensive review of the data items and specifications developed by AGC for the NERVA Program Specification and the NERVA Engine Specification was made by WANL and documented to AGC. The Full Flow Cycle trade study being conducted by AGC was supported by WANL relative to the NSS interaction. Numerous other engineering and test results are reported. A NERVA reorganization was effected to set up a systems management function to centralize the control of and responsibility for the NSS systems engineering work. This was necessary to implement the AFSCM 375 procedure required by the program. At the same time, a technology function was established to separate the XE and PEWEE technical control and responsibility from the mainstream NERVA Development work. (auth)

25317 (WANL-PR(J)-054) NERVA NUCLEAR SUBSYSTEM. Progress Report, 1 April 1969–30 June 1969. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Jul 1969. 154p. Dep. NTIS $10.75.

Declassified 11 Sep 1973.

Performance testing of the XE-PRIME reactor occurred during this period, with special attention to actuators, xenon measurements, etc. Fuel element development continued for the PEWEE-1 and PEWEE-2 reactors. Various design and trade studies for NERVA were completed. (LTN)

25318 (WANL-TME-004) RADIATION ENVIRONMENT AROUND SHIELDED KIWI B-1 REACTOR. Faught, H. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 4 Jan 1962. 8p. Dep. NTIS $4.00.

Declassified 14 Jul 1975.

Plots of gamma ray iso-fluxes, iso-dose rates, fast neutron iso-dose rates, and total iso-dose rates around a shielded KIWI B-1 reactor are presented. Thermal and fast neutron fluxes along the centerline as a function of source-detector separation distance are included. Fast neutron fluxes for 26 energy levels at a distance of 5 feet from the core center are presented in tabular form. Program 14-0 was used to calculate the gamma ray data and fast neutron dose rates. Neutron fluxes were obtained by normalizing the output of a P1 diffusion code to the 14-0 fast neutron output. Dose rates at angles greater than 45° are somewhat different than those contained in the memorandum dated September 15, 1961, due to improvements in the calculations. (auth)

25319 (WANL-TME-170) MECHANICAL STUDY OF NRX-B FORGED SUPPORT PLATE HEIGHT. Eggers, A. G.; Holman, R. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Sep 1962. 6p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

A brief study was made to investigate pertinent mechanical, flow and thermal parameters related to NRX-B support plate height. The common bases of comparison are cooling flow inlet conditions, load (150 psi total of g load, spring, load, and pressure drop) and bending stress (60,000 psi). No attempt was made to investigate thermal stresses. The study indicated that some reduction in the plate height could be tolerated. Significant increase in pressure drop and temperature gradients were found, however, establishing the limit in reduction of plate height to less than 15 percent. As the overall plate height is reduced, the

outer flange plate thicknesses must be increased. Both top and bottom plate thicknesses may be increased or either may be held constant. If the top plate thickness is increased, the steady state thermal stress increases. Therefore, both symmetrical plates and constant top plate thickness were considered. The second arrangement is obviously less efficient structurally since the thin top flange is farther from the plate centroid and, therefore, experiences higher stress than the bottom plate. This concept is extremely poor for plate heights smaller than 5 inches and becomes unacceptable due to the thermal gradient in the thickened plate at the nozzle end. (auth)

25320 (WANL-TME-411) REDESIGN OF THE NRX-A REACTOR CORE PERIPHERY. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jul 1963. 53p. Dep. NTIS $5.75.

Declassified 10 Sep 1973.

Late in November 1962, the KIWI-B4 reactor was subjected to a hot test. Severe mechanical difficulties were experienced which have justified the concern about vibration. These difficulties resulted in a number of revised design objectives for the NRX-A core periphery. These objectives were established as the direct result of considerable interchange of ideas and design concepts between WANL and LASL personnel during discussions concerning the mechanical difficulties observed in the test. These five objectives are: Limit the access of cool gas to the core periphery in order to prevent leakage of this cool gas into the core and thereby reduce potential thermal stress problems; insure that the pressure between fueled elements will be no higher than the external pressure on the bundled core in order to eliminate separation and fluttering of the core elements; permit axial and radial thermal expansion of core and peripheral components without damage; provide a means of absorbing shock, steady and vibratory loads; and define a design sufficiently flexible to be able to accomodate changes in magnitude of the bundling load applied to the core without major changes in components. (auth)

25321 (WANL-TME-419) REPORT OF VISIT TO NRTS JUNE 26-27, 1963) TO EXAMINE FEASIBILITY OF CONDUCTING DYNAMIC NERVA FUEL IRRADIATION EXPERIMENTS. Boltax, A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Jul 1963. 10p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

The need for radiation effects studies on NERVA fuel elements is based on uncertainty as to the capability of the graphite fuel elements to resist cracking at reactor conditions. If problems in this area are encountered, irradiation in test reactors would be preferable full seals NERVA reactor tests. The possibilities of using several existing, and some conceptual, reactors was discussed with respect to available flux, cost, availability, etc. (LTN)

25322 (WANL-TME-544) THERMAL STRESS STUDIES ON UNFUELED NERVA ELEMENT. Feild, A. L. Jr.; Monkelis, M. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1963. 18p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

A study was conducted to investigate the thermal stress behavior of a section of unfueled, uncoated NERVA B-4 element under various applied transverse thermal gradients. The objective was to simulate the thermal aspects of the hydrogen leakage flow condition of peripheral core elements on a laboratory scale, and to determine the resultant mechanical behavior due to the imposed thermal gradients. Direct electrical resistance heating of the element was used to create center temperatures corresponding to those which would be produced under actual reactor operating conditions. Surface cooling was provided by natural radiation or forced convection cooling, depending on the thermal gradients desired. The results of the study, which included steady-state and thermal cycling experiments, revealed that under the experimental conditions gross fracture, incipient cracking, or distortion in the element section did not occur. The maximum thermal gradient was 558°R between element center and surface. The appearance of the element remained the same throughout all the tests. (auth)

25323 (WANL-TME-546) FEASIBILITY OF A FULL CORE NUCLEAR POISON SYSTEM FOR USE DURING RIFT LAUNCH OPERATIONS. Call, D. W.; Hemmerle, E. H.; Kraig, H. I. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1963. 32p. Dep. NTIS $4.75.

Declassified 11 Sep 1973.

One of the prime safety considerations associated with the RIFT vehicle assembly and launch at Cape Cavernal is preventing an accidental reactor excursion in the proximity of the launch site. In addition to the normal operations with the nuclear subsystem, accidents resulting from malfunction of the lower chemical stages can lead to the production and release of fission product material. Two basic characteristics of the NRX reactor complicate the problem of safeguarding against accidental criticality. It is a relatively small reactor with fissioning due principally to intermediate energy neutrons. Hence, the neutron leakage is large and the uranium inventory is much greater than that for a comparable size thermal reactor. In addition, a considerable volume of the core is void and, since propellant must be discharged, it is impossible to contain the reactor in a sealed vessel. Immersion of the reactor in water, which is in abundance near the launch pad, can add reactivity both by increased reflection externally and increased moderation internally. Increased internal moderation is so effective that small sections of the core can be independently critical. The requirements for the system which will protect against accidental criticality follow from the discussion above. It must use a nuclear poison which is dispersed throughout the core and must remain in the core during vehicle assembly, count down and the initial period of booster operation. The system resulting from this study consists of approximately 2,000 boron-10 wires inserted in the coolant channels of the fuel elements and distributed uniformly throughout the core. A shutdown of 5% ΔK is achieved with the reactor fully immersed in water. The principal factors determining the feasibility of such a system were the potential damage that could be caused to the fuel element coolant channels and support blocks by rapidly removing the poison wires and the mechanical equipment required for the wire removal. The experimental program established the feasibility of using poison wires coated with teflon and demonstrated that the forces required for their removal are not excessive. About 2150 pounds is needed to pull the wires from the coolant channels. Initial attempts with uncoated wires were not successful. Three to four times the force was required to pull the uncoated wires and the fuel element cluster blocks were damaged in the process. Conceptual designs of a poison wire retention device, a pull head and an actuator system are presented. (auth)

25324 (WANL-TME-563) METALLURGICAL EVALUATION OF THE NERVA NRX-A TIE ROD FABRICATION PROCESS. Harrod, D. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Nov 1963. 25p. Dep. NTIS $4.25.

Declassified 11 Sep 1973.

A fabrication development program has been conducted to define a suitable process for making tie rods for NERVA NRX-A reactors. As a result of this program, a fabrication process and heat treatment have evolved which yield regular tie rods having a sound metallurgical structure and the mechanical properties expected of the materials. Internal structural defects have been prevalent in instrumented tie rods; however, in spite of these defects these tie rods have exhibited the mechanical properties expected of them. Inconel X-750 and Inconel 718 alloys were studied in this program and both are amenable to fabrication by the process developed. Raw material specifications and process specifications have been developed covering both materials. (auth)

25325 (WANL-TME-565) INTERNAL TEMPERATURES OF FUEL ELEMENTS DURING ENVIRONMENTAL TESTING. Chi, J. W.; Ferris, J. R.; DeZubay, E. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Oct 1963. 44p. Dep. NTIS $5.25.

Declassified 11 Sep 1973.

To date, all nuclear fuel elements proposed for a nuclear rocket have been tested environmentally in a high pressure vessel using an external helium atmosphere. During such tests, the heat generated in the element by resistance heating is removed by forced convection heat transfer to the hydrogen coolant flowing in parallel channels within the element by surface radiation to the shielding, and by convective heat transfer to the helium atmosphere. The mechanisms of heat generation and heat transfer encountered in the environmental tests are different from those expected to occur in the nuclear reactor. An analytical study has been made on the environmental tests performed on nuclear rocket fuel elements. The significance and interpretation of measured fuel element surface temperatures are discussed. An electric analog and mathematical models of the fuel elements were studied to determine the effect of radiation losses on the temperature gradients in the fuel elements during environmental testing. The results permit the determination of maximum internal temperatures from surface temperature measurements. (auth)

25326 (WANL-TME-566) NRX-A1 ALUMINUM BARREL. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1963. 26p. Dep. NTIS $4.50.

Declassified 11 Sep 1973.

The NRX-A1 cold flow aluminum barrel is described and the changes in the barrel design and the reasons for the changes are documented. Stress analysis shows that the cold flow test will not be compromised by the barrel changes. (auth)

25327 (WANL-TME-572) STRESS ANALYSIS OF NRX-A OUTER REFLECTOR SECTORS AND TIE BOLTS. Stancampiano, P. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1963. 62p. Dep. NTIS $6.25.

Declassified 11 Sep 1973.

The stresses in the beryllium sectors and tie bolts of the NRX-A outer reflector due to assembly and full power steady state mechanical and thermal loads have been analyzed in detail, including the effects of thermal gradients, bolt preloads, pressure loads and reactor loads. (auth)

25328 (WANL-TME-577) NRX-A HYBRID (ANALOG-DIGITAL) CORE SIMULATION. Gurski, P. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Oct 1963. 29p. Dep. NTIS $4.50.

Declassified 11 Sep 1973.

Accurate dynamic simulation of reactor components is of utmost importance for control studies. Advanced techniques must be investigated to insure that models are continually upgraded, as required, commensurate with state-of-the-art simulation techniques. Thus, an NRX-A hybrid reactor core was developed to determine its applicability for control analysis simulations and also to evaluate the hybrid technique for quantitative application. An NRX-A hybrid core was developed and a successful simulation was conducted by WANL at the Princeton Computation Center of Electronic Associates Incorporated. The model performed satisfactorily in the 10-100% power range yielding real time, transient, spatial profiles of core variables. (Spatial information was previously not available in real time, analog simulation.) Exit gas temperature transients obtained compared favorably with established digital and analog transient results. The NRX-A hybrid core was coupled to real time power and temperature controller simulations without difficulty demonstrating suitability for control study applications and compatibility with control hardware. Thus, effects of controller operation on internal temperature transients and rates of change might be analyzed with the hybrid core. In addition, the hybrid core model provides a basis for further development and detailed simulation as dictated by control analysis requirements. In general, the hybrid technique proved to be reliable as evidenced by repeatable results. Hybrid methods may be extended to simulations of other reactor components, in particular those components where spatial distributions and interactions are important such as the reflector region. (auth)

25329 (WANL-TME-590) FABRICATION DEVELOPMENT OF SHIELDING MATERIAL. Filippi, A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Nov 1963. 24p. Dep. NTIS $4.25.

Declassified 11 Sep 1973.

A study was undertaken to establish the feasibility of producing dense lithium hydride pellets by cold pressing commercial powder. This study stemmed from the requirement to investigate methods of fabricating the material for NERVA shielding applications. It was found that commercial powder (-16 + 40 mesh) could be cold pressed easily to densities within a few percent of theoretical. A rough density (gms/cc)-pressure (psi) relationship is: $D = 1.12 \times 10^{-6}P + 0.682$ for pellets of moderate length to diameter ratio. The effect on density caused by the pressure dwell time and length to diameter ratio is slight. An approximate relationship for the effect of length/diameter on density is $D = -0.027 (L/d) + C$, where C is a constant dependent upon pressing pressure and dwell time. These results established cold powder compaction as an acceptable lithium hydride pelletizing procedure, and cold pressing methods similar to those used in the nuclear industry for UO_2 were eventually used to fabricate LiH for the first NERVA shield. Heat treatment of LiH pellets results in particle fusion with the loss of discrete particle interfaces. This phenomenon is thought to be a result of sintering, and may improve the low temperature thermal conductivity of the material by eliminating discrete particle boundaries. (auth)

25330 (WANL-TME-595) REVIEW OF A PROJECTED 1/12 SEGMENT REFLECTOR TEST. Chi, J. W.; Ferris, J. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Nov 1963. 10p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

Transients during NRX-A reactor operation which involve two-phase flow in the outer reflector introduce uncertainties of flow, temperature and pressure in its multi-passage cooling system and uncertainties of temperature distribution in its beryllium structure. Analytical studies which have defined flows through the reflector during transient conditions such as reactor start-up have used heat transfer coefficients whose correlation for generalized application is subject to improvement. The concept of quality of the fluid when not in thermal equilibrium and the faulty use of vapor and liquid mass fractions together with temperature of the superheated vapor have inhibited accurate analysis. Heat transfer correlations from Project 8940 are an initial step to improve input to the computer program for analysis of flow and temperature distributions. A 1/12 segment reflector test would be a second step to the realistic determination of these flows and temperatures in the reflector and to a detailed understanding of the mechanics of heat transfer to boiling hydrogen. Fundamental data would be obtained for correlation and generalized application. Under normal reactor operation, on the test stand and in flight, liquid hydrogen is expected to enter the reflector from the nozzle only during start-up and during cooldown flows, both pulsed and steady, after shutdown. This liquid phase would appear first in the reflector as a mist and progress as a function of time to slug flow, bubbly flow involving nucleate boiling and then liquid flow, all as a result of the cooling down of the nozzle. When the flow is observed simultaneously at, say, the entrance of the reflector and at other stations progressing downstream, the sequence of two-phase flow is from bubbly flow to slug flow and then to mist flow as the temperature difference of wall and liquid increases. Since film boiling can be accompanied by pressure oscillations and since flow from the nozzle coolant passages to the reflector encounter abrupt changes in flow direction, initial distributions in the reflector entrance can not be expected to be uniform under off-design start-up conditions. This entrance maldistribution could be aggravated by increased flow of the liquid in those passages which have the greatest flow rate. Under exaggerated time conditions, for instance, a prolonged start-up, liquid can conceivably enter the reactor core, resulting in a severe control problem. (auth)

25331 (WANL-TME-597) CONTRIBUTION TO THE SEVENTEENTH HIGH TEMPERATURE FUEL COMMITTEE MEETING, DECEMBER 3-5 1963. Boltax, A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Nov 1963. 33p. Dep. NTIS $4.75.

Declassified 11 Sep 1973.

A portion of the high temperature fuel element materials program for the development of the NERVA nuclear rocket engine is described. The principal topics include: description of NERVA reactor and fuel element; properties of NERVA fuel elements; and high temperature fuel element studies. (auth)

25332 (WANL-TME-658) GRID LINE MARKINGS ON CORE EXIT SURFACE OF NRX-A1 FOR PHOTOGRAPHIC PURPOSES WITH AGC NOZZLE. Goldberg, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Jan 1964. 3p. Dep. NTIS $4.00.

Declassified 22 Jul 1975.

25333 (WANL-TME-743) SHIELD OPTIMIZATION STUDY FOR NERVA. Woodsum, H. C.; Romesburg, C.; Planinsek, F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1964. 26p. Dep. NTIS $4.50.

Declassified 11 Sep 1973.

A shielding optimization code has been written and sixty combinations of elements and compounds have been processed to determine their suitability for use in a NERVA shield. The main purpose was to determine candidate materials which might lead to a cheaper and simpler shield design than the previously built and tested lithium hydride-stainless steel KIWI B-5 shield. Based on the criterion of minimum shield weight, subject to the constraints of 90% total energy attenuation and an incident neutron to (primary) gamma dose ratio of 1.5, the most promising candidate materials determined by this study have been listed. (auth)

25334 (WANL-TME-744) THERMAL ANALYSIS OF HIGH TEMPERATURE FUEL ELEMENT CORROSION TESTS. Phillips, R. B.; Cort, G. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1964. 52p. Dep. NTIS $5.75.

Declassified 11 Sep 1973.

An analysis of the fuel element corrosion test (test A-2) of the NRX-A component test program has been made. Calculated results are presented which show the temperature distribution in the fuel elements and the flow rate, temperature, and pressure distribution of the hydrogen in the coolant channels, for standard test conditions. A comparison is made between calculated and measured results to partially verify the analytical approach used in the thermal design of the NRX-A reactors. A comparison of the fuel element thermal and flow characteristics in the corrosion test and the NRX-A2 is presented. Modifications to the test hardware, instrumentation, and operating conditions are recommended to better verify the heat transfer analysis of the fuel element corrosion test. (auth)

25335 (WANL-TME-745) INTERPRETATION OF NRX-A1 DRUM TORQUE MEASUREMENTS AND RECOMMENDED NRX-A2 MODIFICATIONS. Rieke, K. L.; Marttilla, R. W.; French,

J. W. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 15 May 1964. 76p. Dep. NTIS $7.00.
Declassified 14 Jul 1975.

In an effort to determine the reason for the high torques on the NRX-A1 Control Drums, the torque and temperature data recorded during cold flow testing at NRDS were analyzed. The results indicated that transverse temperature gradients were causing drum bowing which resulted in contact between the control drum and the outer reflector sector. As an interim solution for the NRX-A2 Reactor, an additional drum clearance of 30 mils will be provided by reboring the outer reflector sectors. Prechilling of the reactor and adjustment of the start-up ramp will provide additional assurance of satisfactory operation. To arrive at an optimum solution for all NRX-A type reactors, a number of possibilities are being investigated. A decrease in the diameter of the control drum and adjustment of the orificing to reduce the temperature gradient across the drums are being considered. Drum component tests are planned to investigate bowing as a function of transverse temperature gradient, and rubbing friction as a function of sector interference. Sector web testing will be performed to verify analysis of web stresses as a function of thickness. (auth)

25336 (WANL-TME-747) NE 8020 A: REVISION OF CRSAVE. Ortenberg, L. I. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 9 Apr 1964. 7p. Dep. NTIS $4.00.
Declassified 14 Jul 1975.

Since the initial coding of the CRSAVE program and its subsequent placement in production, special problems have arisen which have required minor changes in the program. In order to treat these problems and to make the program more general and versatile, a recording was performed. This memorandum discusses briefly the additional features of the program and details the new input scheme. CRSAVE calculates a single, flux-weighted, region-averaged thermal cross section from TNS multithermal group constants and DSN multithermal group fluxes for use in CURE, AIM-5, etc. This particular use of CRSAVE is described fully in WANL-TMI-404; however, the attached input description should be followed for input preparation if object deck AR6 is used. (auth)

25337 (WANL-TME-758) THERMAL AND NUCLEAR DESIGN REVIEW OF THE NRX-A5 REACTOR. Black, D. L.; Minners, W.; Stefanko, J. S.; Vijuk, R. M. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 15 May 1964. 95p. Dep. NTIS $7.75.
Declassified 14 Jul 1975.

A thermal and nuclear NRX-A5 Design Review was held at WANL on April 10, 1964. Analyses and planning performed to date on the NRX-A5 and subsequent reactors were presented. Systems analyses were performed on various "cooled periphery" and "hot periphery" seal configurations. A number of inner reflector designs were examined, as well as means for cooling the lateral support springs. Core component redesign included methods for controlling inter-element pressure distribution by undercutting or chamfering of fuel elements. Changes in tie rod diameters, use of as-extruded fuel elements, and performance analysis of the various systems were also described. Nuclear analysis was confined to parametric studies on excess reactivity and control drum span for inner reflector material combinations of graphite, aluminum, and/or beryllium. Changes required to more precisely define the NRX-A5 were discussed together with effects associated with the higher power capability envisioned for subsequent reactors. (auth)

25338 (WANL-TME-767(Suppl.1)) ANALYSIS OF KIWI B4A RADIATION MEASUREMENTS. Stephenson, L. D. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). May 1964. 16p. Dep. NTIS $4.00.
Declassified 14 Jul 1975.

An analysis of the KIWI B4A reactor was presented for comparison with measured KIWI data in WANL-TME-767. A description of the KIWI B4A analytical mockup (including dimensions), material volume fraction data, fission density distributions and power level data for the KIWI series of reactor tests are presented. (auth)

25339 (WANL-TME-773(Suppl.1)) NRX-A1 THERMAL AND FLUID FLOW PERFORMANCE. Blivin, C. R.; Bowman, L.; Davidson, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Sep 1964. 75p. Dep. NTIS $6.75.
Declassified 11 Sep 1973.

As a result of additional data analysis, data reduction, transducer calibration, and instrumentation lead identification checks, several anomalies in the NRX-A1 test results have been resolved and are reported. Considering the results of all NRX-A1 data analysis to date, a summary of the significant results pertaining to thermal and fluid flow performance is given. (1) Choking in the orifice sleeves caused the NRX-A1 core pressure drop to be higher than originally expected under some flow conditions. (2) Excessive control drum torques and radial temperature differences higher than predicted occurred during the cold gas and liquid hydrogen simulated startups. (3) The hydrogen supplied to the reactor was less than the desired flow rate for the early part of the liquid hydrogen simulated startups. This deviation in reactor flow is attributed to hydrogen storage in the facility piping and mixing chamber. Approximately 60 pounds less hydrogen flowed through the reactor than was scheduled for the liquid hydrogen NRX-A1 tests. (4) The lateral support seal axial pressure distributions from the NRX-A1 test results agree favorably with the results of the A-11 flow vibration component test. (5) There is no evidence in support of the existence of fluid flow excited vibrations; in fact no large vibrations either forced or self-excited were found. (6) During the liquid hydrogen NRX-A1 tests temperature asymmetries occurred in the reflector inlet plenum for the Aerojet General nozzle and the Rocketdyne RN-6 nozzle. These transient temperature asymmetries correlate with the feed lines to the nozzles. On the basis of KIWI-B tests performed with the Rocketdyne "spider" feed line arrangement, it appears that if the feed line oriented asymmetry persists after chilldown is complete, its magnitude will be small. (7) A comparison of calculated and experimental NRX-A1 fluid pressures and temperatures obtained from the transient analysis program (TNT) confirm the calculational method. Calculated detail material temperatures in reactor components tend to agree reasonably well with experimental values with the exception of control drum temperatures. (auth)

25340 (WANL-TME-776) WESTINGHOUSE ASTRONUCLEAR LABORATORY CONTRIBUTION TO THE EIGHTEENTH HIGH TEMPERATURE FUEL COMMITTEE MEETING, MAY 19, 20, AND 21, 1964. Tobin, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 May 1964. 37p. Dep. NTIS $5.00.
Declassified 14 Jul 1975.

Advances in the high temperature fuel element materials program for the development of the NERVA nuclear rocket engine are described. The principal topics include: review of NERVA reactor fuel system, high temperature studies of fuel element components, and steady-state irradiation experiments. (auth)

25341 (WANL-TME-784) STATUS REVIEW OF NRX-A REACTOR REDESIGN. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1964. 89p. Dep. NTIS $7.50.
Declassified 11 Sep 1973.

The presentation, intended as a design status review of the design and experimental work performed to date on the NRX-A5 through NRX-A7 reactors, concentrated on evaluating program accomplishments against the overall objective of developing a reactor sufficiently reliable to serve as the basis of an engine development program. Methods of controlling core radial inflow, increasing the load-carrying capability of the inner reflector, and developing a configuration which would eliminate the possibility of inner reflector-nozzle separation are discussed. The second area discusses the design work done in specific areas such as the inner reflector, outer reflector, and the reactor, cluster and core assemblies. Some of the more significant materials development work, particularly as it relates to evaluation of a segmented inner reflector, is also presented. The reader should be acquainted with certain preliminary findings which appreciably affected the design philosophy of the program. During recent evaluations of the NRX-A design, it was found that most of the components had load design margins which could be improved significantly if the components were modified only slightly, if at all. In addition, it was estimated that the power demands which could be anticipated for various mission requirements may be greater than provided for in the current NRX-A reactors. After evaluating all of the available data, it was decided that it was both good engineering practice and sound economics to anticipate and provide for this growth potential, particularly if these provisions could be made without compromising existing schedular commitments. These provisions will also serve to increase reliability at the current power level. (auth)

25342 (WANL-TME-788) PERMEABILITY OF THE ND215 REIMPREGNATED INNER REFLECTOR CYLINDER: DATA ANALYSIS AND DESIGN SIGNIFICANCE. Miller, A. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 1 Jun 1964. 11p. Dep. NTIS $4.00.
Declassified 11 Sep 1973.

An analysis of the permeability test data obtained on a reimpregnated inner reflector cylinder, similar to that which is to be used on the NRX-A2 reactor (ND10202), indicates the following

items of design significance: The reimpregnation of the ND215 inner reflector cylinder reduced the amount of porous flow by a factor of approximately 80; the porous flow through the reimpregnated inner reflector cylinder test specimen can be expressed by a formula which is given; and the porous flow through the reimpregnated inner reflector cylinder exerts a small effect on the seal pressure distribution. The accumulated seal flow rates show a slight change from that calculated with no porous flow. This change would be revealed in a hot test as an increase in seal bulk fluid temperature over the dome-end half of the core and a reduced seal bulk fluid temperature over the nozzle-end half of the core. Therefore, it is recommended that the effect of porous flow, although small, be included in the analyses of the seal operating characteristics during any power test. It is concluded that the magnitude of the porous flow through the inner reflector cylinder of the NRX-A2 reactor is small and will have no deleterious effects on the successful operation of the test. A correlation has been developed for use in the analysis of the seal operating characteristics. (auth)

25343 (WANL-TME-791) REPLACEMENT OF INCONEL X-750 WITH INCONEL 718 FOR NRX-A COMPONENTS. Hoppe, A. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 23 Sep 1964. 39p. Dep. NTIS $5.00.

Declassified 11 Sep 1973.

The material for NRX-A reactor tie rods and nozzle end seal rings is being changed to Inconel 718 to take advantage of its superior strength, fabricability and resistance to stress-corrosion cracking or age-cracking. The change in tie rod material will be effective with NRX-A4, and for the nozzle end seal ring, the change was effective with the NRX-A2 reactor. The purpose of this report is to review the original basis for material selection, and the superior physical and mechanical properties and fabricability of Inconel 718 compared to Inconel X-750 as well as the similar irradiation effects behavior of the two alloys. A summary of all known irradiation effects data is included and recommendations for future work are listed. (auth)

25344 (WANL-TME-792) PLUGGED CORE FLOW TEST REPORT. Phase I Tests: Prerequisite to NRX-A2. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Aug 1964. 264p. Dep. NTIS $16.25.

Declassified 11 Sep 1973.

The results of the Phase I Plugged Core Flow Tests, which were established as prerequisite to the testing of NRX-A2, are reported. Experimental procedures and equipment as well as the design of the test model are set forth. Experimental measurement of seal chamber and core interelement pressure distributions, leakage flow rates, mechanical stress and strains, and component movements are presented for twenty steady-state tests at pressure levels from 55 to 575 psia using gaseous hydrogen at ambient temperature. The experimental results are compared with analytical models for seal pressure distribution, core interelement pressure distribution, flow rates, and inner reflector and barrel movement and the analytical techniques employed in reactor design calculations are discussed. (auth)

25345 (WANL-TME-812) INTERIM REPORT: DISASSEMBLY AND INSPECTION OF NRX-A1 REACTOR. DeStefano, J. (Westinghouse Electric Corp., Large, Pa. (USA). Astronuclear Lab.). 15 Jun 1964. 15p. Dep. NTIS $4.00.

Declassified 22 Jul 1975.

The preliminary results of the disassembly and inspection of the NRX-A1 reactor are reported. No major defects were disclosed; among the discrepancies noted were some fuel element orifice blockage, minor surface scoring of the control drums, hairline fractures at the nozzle end spigots of the outer reflector, some unbonded strain gages, and oil smears on reactor hardware. Spectrographic analysis indicated that the oil was Rocketdyne Soluble Oil, used during construction of the reactor nozzle. (auth)

25346 (WANL-TME-826) TEST SERIES FFL-7: AN EXPERIMENTAL DETERMINATION OF THE LOSS COEFFICIENTS FOR THE INNER IMPEDANCE RING USING AIR AND HYDROGEN. Gormley, O. P.; Morrison, H. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Oct 1964. 109p. Dep. NTIS $8.50.

Declassified 10 Sep 1973.

The impedance ring in the inner reflector-outer reflector annulus of the NRX-A2 reactor is a means of balancing flow in that region with the flow in other parts of the reflector system. The ring is welded to the aluminum barrel which forms the inner diameter of the flow annulus. The outer diameter is formed by the outer reflector. The flow area of the impedance ring is determined by the machined slots cut into it, and by the clearance between the ring and the inner diameter of the outer reflector. Results of flow tests performed using hydrogen gas at ambient temperature and an inlet pressure of 750 psig are presented. Data was obtained for the metering rings having design dimensions and for nominal annulus clearances of .080 and .130 inches. A comparison is given between the loss coefficients and friction factors for these data and values from the previously reported air data. From the values obtained for the various loss coefficients using both air and hydrogen, which are within the accuracy one would expect using the above measuring techniques, it may be concluded that air tests can be used to predict the necessary flow parameters. Thus, the expense and experimental difficulties connected with hydrogen testing may be avoided when loss coefficients for these types of geometries are to be determined. (auth)

25347 (WANL-TME-827) THERMAL CAPSULE CALIBRATIONS. Filippi, A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Jun 1964. 72p. Dep. NTIS $6.75.

Declassified 10 Sep 1973.

Twenty-seven thermal capsule materials to be used in determining NERVA core temperatures have been calibrated. These cover the range of temperature from 660° to 2800°C, and consist of 11 metal-graphite combinations chosen by WANL and 16 chosen by LASL. (A thermal capsule consists of a 0.040″ diameter × 1/4″ long pointed metal wire enclosed in a graphite case.) Calibration was performed on 22 combinations by observing the lowest temperature at which the wire point deformed. Difficulty, however, was encountered with this procedure when calibrating five of the high-temperature capsule materials. These wires, four niobium-tantalum alloys and pure tantalum, readily formed surface carbides during calibration which resisted deformation even when internal melting occurred. The detection of melting by observing a change in wire tip geometry was, therefore, inadequate, and instead calibration was accomplished metallographically. All combinations, with one exception, showed melting within ± 50°C of the predicted temperature. (auth)

25348 (WANL-TME-887(Suppl.3)) NRX-A2 LOW POWER-LOW FLOW PERFORMANCE TEST. Knecht, W. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA) Astronuclear Lab.). 13 Oct 1964. 26p. Dep. NTIS $4.50.

Declassified 14 Jul 1975.

Calculated reactor performance data are presented for a low power-low flow test with the NRX-A2 reactor. The major objectives of such a test are: 1. To verify the capability of the reactor to operate in a stable manner at the low flow rates achievable with dewar pressure. 2. To obtain reactor performance data in the low power-low flow operating regime so that the analytical techniques may be checked. 3. To demonstrate stable reactor operation with core inlet temperatures below 90°R, and 4. To demonstrate stable reactor operation with locked control drums, and flow control. (auth)

25349 (WANL-TME-1103) PRELIMINARY ANALOG STUDIES OF NRX/EST TESTS. Thompson, R. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Feb 1965. 22p. Dep. NTIS $4.25.

Declassified 10 Jul 1975.

Preliminary analog studies of potential NRX/EST tests have been performed. The purpose of these investigations was to support preliminary test planning analyses, to verify general feasibility of tests proposed for NRX/EST, and to provide guidance for more detailed analyses to follow. These studies were to be the first of many to be performed for the NRX/EST test series, and as such, no attempt was made to optimize specific test profiles. It has been concluded that: (1) The concept of maintaining constant control drum position during startup from the sub-power hold and during shutdown from rated conditions is feasible. Further studies are required to optimize startup schedules so as to prevent brief intervals during which there is an excessive rate of chamber temperature increase, and to optimize shutdown schedules to assure that the tie-rod temperature limit is not exceeded. (2) It appears feasible to perform startup and shutdown transients near the tie-rod limit, and to schedule these transients through relatively simple adjustments to the nominal control system. Further analyses are required to determine specific test profiles. (3) The proposed test wherein startup and shutdown transients are to be scheduled near the feedback reactivity limit appears feasible, but further analyses are required to substantiate this conclusion. Recommendations are made for further work and for improvements in the analog model. (auth)

25350 (WANL-TME-1243) NRX-A3 POST-OPERATIVE MECHANICAL COMPONENT EVALUATION. Linde, D. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1965. 99p. Dep. NTIS $8.00.

Declassified 12 Sep 1973.

Upon completion of the NRX-A3 Test Program in June, 1965, the reactor was disassembled under controlled conditions, and a post-operation evaluation of all mechanical components was performed. The primary objectives were to obtain information relative to design adequacy and to properly interpret and disseminate this information. The evaluation showed that generally the reactor was in excellent condition. An overall comparison of performance with that of NRX-A2 shows that the full power operating time credited to NRX-A3 exceeds that of NRX-A2 by a factor of at least ten while the end condition of NRX-A3 components was as good if not better than those of the NRX-A2 in most cases. Inspection results emphasize the need for further developments in graphite coating technology. The major corrosion damage to fuel elements occurred around the undercut area near the aft end tip; pinholing at defects in the bore coating; cracking of the bore coating; and along the length of externally coated partial elements. An interstitial corrosion pattern, similar to NRX-A2, appeared as a band across the mid-plane of the core. The resulting deposits caused elements to tend to stick together. In a few cases elements were permanently bonded together. No fueled or unfueled elements were broken during the tests. Evidence of rubbing between the control drum and the wall of the outer reflector sector was found. This was attributed to a thermally induced bow of the control drum during operation. One weld failure was found on a control drum housing due to inadequate clearance. A cracking problem was identified in the support block aft counterbore. These cracks allowed a flow which attacked other graphite cluster hardware and the support blocks. There were no visible signs of damage or wear associated with the metallic parts of the reactor. Some minor difficulty was experienced in the remote disassembly of threaded connections. The performance of the instrumentation was very satisfactory. Approximately 97 percent of the instruments remained operational throughout the test series. (auth)

25351 (WANL-TME-1244) RESULTS OF BETA BACKSCATTER DATA EVALUATION. Horton, W. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Aug 1965. 20p. Dep. NTIS $4.00.

Declassified 12 Sep 1973.

A program to examine data generated by the Union Carbide Y-12 automated beta backscatter test equipment was initiated. This equipment is designed to determine the niobium carbide thickness of coated fuel elements. Four code nine elements and two elements each of the other six codes were selected and processed as standard production elements with repeated beta backscatter determinations and metallographic observations of niobium carbide thicknesses obtained for each. The conclusions and recommendations based on an analysis of the data are summarized. Beta backscatter calibration data can be expressed as a linear function between counts and log thickness only if calibration standards between 0.0 and 1.7 mils niobium are used. A discontinuity in the relationship between counts and thickness is observed between 1.7 and 2.1 mils. Therefore, it is recommended that calibration curves for production data be evaluated for standards having thickness values less than 1.8 mils such that an expression of the following form is derived: log thickness = a + b (counts). The use of three counts per niobium standard for the proposed four standards is sufficient for determining the calibration curve although the variability in the determination of the curve can be reduced by an increase in the number of counts. If three counts per standard are taken, these should agree within 8 units. Previously a constant, 1.235, had been used to convert niobium thickness to niobium carbide thickness. This conversion was not sufficiently accurate to obtain agreement between the beta backscatter results and the metallographic results. An empirical relationship is given and recommended for conversion of beta backscatter data to niobium carbide thickness. Since a discontinuity in the calibration curve is observed between 1.7 and 2.1 mils, this automatically places an upper limit of 1.7 mils on the niobium thickness and, per the conversion formula just recommended, an upper limit of 2.7 mils on the niobium carbide thickness. The precision of the automated beta backscatter equipment varies with the thickness being observed. (auth)

25352 (WANL-TME-1298) CORROSION INHIBITOR TESTS. Burghardt, R. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1965. 19p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

As a means of reducing interstitial corrosion within the NERVA core, it has been proposed that corrosion products be introduced into the hydrogen entering the core radially by controlled corrosion on the periphery. A series of tests has been performed at surface temperatures of 3000°R and 4000°R and a pressure of 600 psia to determine the effectiveness of one of these products, methane, in inhibiting corrosion. It was concluded that at a surface temperature of 4000°R methane percentages above about 3 percent by volume would inhibit corrosion and produce a pyrolytic graphite deposit, and that at a surface temperature of 3000°R, percentages above about 5 percent would inhibit corrosion and produce a very thin amorphous deposit. (auth)

25353 (WANL-TME-1601) NRX-A7 CARBIDE-GRAPHITE COMPOSITE DEVELOPMENT PROGRAM, PRELIMINARY REPORT. France, L. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 31 Mar 1967. 16p. Dep. NTIS $4.00.

Declassified 10 Sep 1973.

The performance of the NbC coated ATJ graphite axial support system (support blocks, protection cups and washers) in the nuclear reactors tested by WANL and LASL has demonstrated the degeneration of coating adherence. After approximately 30 minutes of full power operation, severe crazing and flaking of the coating has been observed on a large number of support blocks and protection cups during postmortem examination. A program aimed at improving the retention of coating adherence has been actively pursued both by WANL and LASL. The results indicate that certain high expansion grades of graphite, SX-5 for example, perform better than does ATJ. Recent WANL results indicate that the coating adherence on ATJ after corrosion testing can be improved by decreasing the coating temperature from 2100°C to 1900°C and controlling the coating thickness to within the range of from 2 to 3.5 mils. The simulated corrosion performance of NbC coated composites has proven superior to that of coated graphites. Due to the increased thermal stress sensitivity and lower creep resistance of the composite material a number of questions regarding reactor performance remain to be answered. The work accomplished by WANL on the composite material for A-6 has been mainly limited to property determinations and corrosion testing of the LASL and Carborundum produced material under conditions (time and temperature) applicable to A-6. The results of these tests indicate that the 75 wt.% NbC composite is capable of meeting the design and corrosion protection requirements of the A-6 reactor. The materials department program on composite material intended for use in the NRX-A7 reactor is defined: The present time schedule for materials evaluation and procurement of composite material for component testing dictates that only one composite composition be considered as a prime candidate and the 75 wt.% NbC composite has been tentatively selected as the prime material candidate for NRX-A7 application on the basis of studies performed by LASL. (auth)

25354 (WANL-TME-1720) WESTINGHOUSE ASTRONUCLEAR LABORATORY CONTRIBUTION TO THE 13TH COATED PARTICLE FUELS WORKING GROUP MEETING 12 AND 13 DECEMBER 1967. Fleischer, L. R.; Kilp, G. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1967. 27p. Dep. NTIS $4.50.

Declassified 14 Jul 1975.

Two subjects are discussed: the development and testing of coatings for NRX-A6 fuel elements and the hydrolysis of XE-1 fuel elements which developed in storage. The NRX-A6 fuel elements are first coated with a vapor deposited coating of niobium carbide. These coatings are deposited at a high temperature and crack on cooling. It was found that a molybdenum overcoating further reduced the corrosion by hydrogen by a factor of six in some regions of the fuel element. The coatings are described and an electrically powered hydrogen corrosion test for the qualification of these fuel elements and the results of the tests are given. The XE-1 reactor was assembled in April, 1967, inerted with 8 psig helium and shipped to the test site where it was stored until mid-August. When it was opened, 45 g of debris of hydrolysed uranium carbide was found along with niobium carbide fragments. This triggered a detailed study of the debris and an investigation of the hydrolysis reaction. It was concluded that some factor such as traces of hydrochloric or acetic acid or chloride ion might have sensitized the more rapid than expected hydrolysis by the traces of desorbed water available. (LTN)

25355 (WANL-TNR-025) NERVA B-2 REACTOR, PHASE 1. NERVA Nuclear Subsystem. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1962. 67p. Dep. NTIS $6.50.

Declassified 10 Sep 1973.

The NERVA Phase 1 design effort for the B-2 reactor was directed towards analyzing the Los Alamos Scientific Laboratory KIWI B-2 design for flight conditions, establishing flight conditions and preparing the necessary preliminary redesign of components as indicated by analysis. Although the analysis is incomplete for all components, there is sufficient depth to indicate problem areas and define areas where redesign is required. Because the NERVA flight environment is significantly different

from the KIWI test environment, several important modifications to the LASL design will be required. Mechanical design criteria and materials selection will be strongly influenced by the requirements of safety and reliability. The reactor for NERVA must have very high reliability and must be safe under all handling and flight conditions. These additional requirements cause changes to the mechanical design, influence the selection of materials, and alter the criteria under which the materials are utilized. (auth)

25356 (WANL-TNR-188(Add.1)) REVIEW OF NERVA FUEL ELEMENT SURFACE TREATMENT. Wilks, P. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1965. 2p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

The tentative model of the gas stream used for coating fuel elements proposed in Part B, Section 2 has been shown to be thermodynamically impossible because of the instability of $NbCl_5$ at the coating temperatures. Moreover, previously unavailable estimates of the thermodynamic properties of $NbCl_2$ have been employed in calculations which indicate that the reaction $NbCl_3 \rightarrow NbCl_2 + Cl$ proceeds largely to completion under the conditions employed in fuel element coating operations. In the absence of $NbCl_3$ data, it had been shown that $NbCl_3$ would be the major specie at the coating temperature. The importance of the possible specie NbCl is not known. Efforts are continuing toward a thermodynamic explanation of the apparent maximum efficiency shown by the data. Nevertheless, the data may be looked upon as valid from an engineering standpoint, in which context they have been of significant value in process control at WAFF. (auth)

25357 (WANL-TNR-194) DESTRUCTIVE TEST EVALUATION OF NRX-A2 FUEL ELEMENTS. Kilp, G. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Jan 1965. 39p. Dep. NTIS $5.00.

Declassified 12 Sep 1973.

In addition to the non-destructive inspections used to qualify fuel elements for the NRX-A2 core, a number of "destructive" test programs were used to monitor production and to characterize production elements. The principal programs and their sampling frequency are summarized. A number of special studies were undertaken for purposes such as setting reactor run limitations, clarifying drawing and/or specification requirements, aiding in the definition and interpretation of test procedures, and general definition of fuel characteristics and capabilities. Studies falling under this category were: Flexure strength non-destructive test correlations, post-hydrogen corrosion test flexure testing, compressive strength testing of corroded ends, residual stress testing, fuel element end regression during hydrogen corrosion testing, hydrolysis behavior of fuel material, and post-corrosion test cooldown simulation tests. Additional work was performed on NRX-A2 fuel elements including thermal diffusivity measurements, eddy current studies of coated bores, electrical resistivity, coated bore roughness measurements, and high temperature mechanical property testing. (auth)

25358 (WANL-TNR-200) DESTRUCTIVE TEST EVALUATION OF NRX-A3 FUEL ELEMENTS. Kilp, G. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 May 1965. 56p. Dep. NTIS $6.00.

Declassified 12 Sep 1973.

Quality control and developmental tests of NRX-A3 fuel elements are described; brief results are given and the programs initiated as a consequence of NRX-A2 and test results outlined. Quality control tests involved flexure, thermal expansion, thermal conductivity, and hydrogen corrosion. Tests applied in development work were flexure and compressive testing (especially of eddy current defects), developmental hydrogen corrosion, and measurements of the unfueled tip strength at various process steps. (LTN)

Reactor Safety and Environmental Aspects

Refer also to abstracts 24331, 24333, 24341, 24343, 24344, and 24358.

25359 (ANCR-1243) SAFETY ANALYSIS REPORT, Decontamination and Decommissioning of the EBR-I Complex. Commander, J. C.; Macbeth, P. J.; Michels, D. E. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jun 1975. Contract AT(10-1)-1375. 60p. (SAR-74-3). Dep. NTIS $5.45.

The safety aspects of the planned EBR-I Complex decontamination and decommissioning operations are assessed. The major operations are: (1) removal of NaK from the EBR-I primary and secondary coolant systems, (2) processing of the NaK to produce solid caustic for disposal, (3) decontamination of contaminated areas of EBR-I and ZPR-III, (4) removal of items that cannot be decontaminated economically to acceptably safe levels, (5) isolation of contaminated areas, (6) demolition of the AFSR Shielding, and (7) removal of contaminated vessels from the NaK storage pit. It may be concluded that although potential hazards do exist from explosion, chemical burns and low-level radioactive exposure from the D and D operation, these hazards represent acceptable risks provided that the established procedures and precautions are followed. (auth)

25360 (ANL/ACEA-101) LECTURE BACKGROUND NOTES ON TRANSIENT SODIUM BOILING AND VOIDING IN FAST REACTORS. Okrent, D.; Fauske, H. K. (Argonne National Lab., Ill. (USA); Arizona Univ., Tucson (USA)). Jan 1972. 240p. Dep. NTIS $15.00.

This set of lecture background notes includes the following: (1) Introductory remarks on fast reactor safety, which are intended to provide some perspective on the role played by sodium boiling. (2) A discussion of superheat which reviews the experimental data and nucleation models with emphasis on the pressure-temperature history effect on radius of active cavity sites, including the role played by inert gas. (3) A discussion of the growth and collapse of spherical bubbles. (4) A historical description of the development of computer codes to describe voiding and a detailed description of the analytical formulation of typical models for calculating voiding due to boiling, fission gas release, and molten fuel-coolant interaction. (auth)

25361 (ANL-CT-76-10) CORTAC: A CORE RESTRAINT TRANSIENT ANALYSIS CODE. Preliminary User's Manual. Fulford, P. J.; Fox, J. N.; Yackle, T. R. (Argonne National Lab., Ill. (USA)). Jul 1975. 181p. AT.

The FORTRAN IV computer code CORTAC developed by ANL and GE-FBRD for the transient analysis of LMFBR core restraint systems is described. The objective of the code is to allow a simultaneous analysis of the coupled reactor core thermal-hydraulics, structural deflections, and reactor kinetics. CORTAC treats the reactor core system as an axisymmetric model consisting of a central cylindrical region and fifteen concentric annular regions. The thermal-hydraulic simulation includes heat conduction between radial regions, gamma and neutron heating of structure and coolant, and time dependent flow rates within and between each region. Each radial region is divided into a maximum of nine nodes, including four representative fuel pin nodes, and up to thirty axial sections. The transient temperature equations use a recently developed conduction-convection heat transfer computational technique. Structural response of the core assemblies is simulated by a routine based on the NUBOW code, previously developed at ANL. The transient prompt neutron and precursor densities are determined by the standard point kinetic equations. (auth)

25362 (CENPD-170) CPC: ASSESSMENT OF THE ACCURACY OF PWR SAFETY SYSTEM ACTUATION AS PERFORMED BY THE CORE PROTECTION CALCULATORS. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Jul 1975. Combustion Engineering, Inc., Windsor, CT.

The methods are described which are used in the Core Protection Calculators (CPC) to process sensor information and initiate a High Local Power Density or Low DNBR trip. A detailed examination of the uncertainties associated with the synthesis of the three-dimensional peaking factor (Fq) and the ability with which the CPC's accommodate CEA misalignments are presented. The uncertainty assigned to the CPC synthesized Fq is 8.5 percent at a 95/95 confidence level. (auth)

25363 (CENPD-201) PERFORMANCE OF C-E SYSTEM 80 REACTOR COOLANT PUMP WITH LOSS OF COMPONENT COOLING WATER. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Aug 1975. 31p. Combustion Engineering, Inc., Windsor, CT.

The effects of the loss of auxiliary cooling water systems to the reactor coolant pump -- motor assembly are examined. The design details of the hardware involved and its performance during such simulated events are described along with appropriate calculations and past operating experience. The results support the following conclusions: (1) The reactor coolant pump-motor assembly can remain operational for a period of at least 45 minutes from the time of the loss of component cooling water. Operation without component cooling water for this time interval does not increase the possibility of shaft seizure or adversely affect coastdown. (2) The postulated loss of the redundant seal cooling systems (component cooling water system and seal injection system), while requiring continued operation of the reactor coolant pumps, is not a credible event. (auth)

25364 (CONF-740523-) CONTAINMENT OF RADIOACTIVITY AND THE USE OF NUCLEAR ENERGY. Proceedings of 7th

International Congress, Versailles, France, 28–31 May 1974. Jarry, H. (ed.). (Societe Francaise de Radioprotection, 92-Montrouge). 1974. 849p. (In French and English).

A separate abstract was prepared for one of the 43 papers included. Abstracts for the remaining papers appeared in NSA Vol. 31, Issue 11. (JWR)

For an abstract of an individual paper see: 25365.

25365 (CONF-740523-, pp 129-146) BEHAVIOR OF NUCLEAR AEROSOLS IN THE POST ACCIDENT ATMOSPHERE OF FAST BREEDER REACTOR CONTAINMENTS: EXPERIMENTAL AND THEORETICAL RESULTS. Jordan, H.; Schikarski, W.; Wild, H. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From 7th international congress of the French Society for Radioprotection; Versailles, France (28 May 1974).

In containment of radioactivity and the use of nuclear energy.

In order to predict the radiation dose to the environment of a fast breeder reactor as a result of a severe accident it is necessary to know the behavior of nuclear aerosols, as the main carriers of activity, in the reactor containment atmosphere. Similarly, such knowledge is needed in order to engineer possibly necessary aerosol suppression systems. The behavior of aerosols in closed containments has therefore been a topic of intensive study at Karlsruhe for some time. A considerable maturity of experience, both experimental and theoretical has resulted, permitting some confidence in the predicted possible response of full scale containments. Representative experimental results are presented including a discussion of the measuring techniques used. Particular importance is placed on aerosol behavior under the influence of a temperature gradient since recent experiments show such gradients to give rise to rapid decay of airborne particulates. A computer model (PARDISEKO III) is discussed and results of calculations compared with experiment. Finally the sensitivity of the model to parameter variation and the possible range of such variations, as determined by experiment, are discussed. (auth)

25366 (CONF-750908-5) SCRAM AND NONLINEAR REACTOR SYSTEM SEISMIC ANALYSIS FOR THE FAST FLUX TEST FACILITY. Morrone, A. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1975. 25p. Dep. NTIS $4.25.

From 3rd international conference on structural mechanics in reactor technology; London, UK (1 Sep 1975).

A description is given of the analysis and results for the Fast Flux Test Facility (FFTF) reactor system which was analyzed for both scram times and seismic responses such as bending moments and impact forces. The reactor system was represented with a one-dimensional nonlinear mathematical model with two degrees of freedom per node. The results give time history plots of various seismic responses and plots of scram times as a function of control rod travel distance for the most critical scram initiation times. The total scram time considering the effects of the earthquake was still acceptable but about 4 times longer than that calculated without the earthquake. (auth)

25367 (DP-MS-74-67) STEAM POCKET FORMATION FROM A SIMULATED NUCLEAR EXCURSION IN A WATER-MODERATED REACTOR MOCKUP. Muhlbaier, D. R. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 28p. (CONF-750804-1). Dep. NTIS $4.50.

From conference on heat transfer; San Francisco, California, USA (11 Aug 1975).

Tests were conducted with a scale model hydraulic facility to determine the behavior of steam injected into subcooled water by fuel assemblies during a postulated nuclear excursion in a Savannah River Plant (SRP) reactor. Results showed that when mockup fuel assemblies are discharging steam, a steam pocket was formed. The steam pocket always remained in the bottom of the tank in contact with its energy source but expanded upward through the tank core at reduced subcoolings. Steam volume and overall heat transfer rate were influenced by the turbulence of both the steam and the water. The steam coexisted with subcooled water. (auth)

25368 (DUN-SA-165) FAULT TREE ANALYSIS FOR REACTOR SYSTEMS. Crosetti, P. A. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 25 Feb 1971. 26p. (CONF-710537-1). Dep. NTIS $4.50.

From 14th power instrumentation symposium; New York, New York, USA (17 May 1971).

Reliability analysis is playing an increasingly important role in quantitative assessment of system performance for assuring nuclear safety, improving plant performance and plant life, and reducing plant operating costs. The complexity of today's nuclear plants warrants the use of techniques which will provide a comprehensive evaluation of systems in their total context. In particular, fault tree analysis with probability evaluation can play a key role in assuring nuclear safety, in improving plant performance and plant life, and in reducing plant operating costs. The technique provides an all inclusive, versatile mathematical tool for analyzing complex systems. Its application can include a complete plant as well as any of the systems and subsystems. Fault tree analysis provides an objective basis for analyzing system design, performing trade-off studies, analyzing common mode failures, demonstrating compliance with AEC requirements, and justifying system changes or additions. The logic of the approach makes it readily understandable and, therefore, it serves as an effective visibility tool for both engineering and management. (auth)

25369 (ERDA-56) STATUS OF SAFETY TECHNOLOGY FOR RADIOLOGICAL CONSEQUENCE ASSESSMENT OF POSTULATED ACCIDENTS IN LIQUID METAL FAST BREEDER REACTORS, CANOGA PARK, CALIFORNIA, 29 JULY–31 JULY 1975. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Jul 1975. vp. (CONF-750719-). Dep. NTIS $13.60.

From safety technology meeting on radiological consequence assessment; Canoga Park, California, USA (29 Jul 1975).

State-of-the-art capabilities are examined for prediction and mitigation of radiological consequences of postulated LMFBR accidents. The following topics are treated: radioactive source terms, sodium reactions, aerosol behavior, radiological dose assessment, and engineered safeguards. (DG)

25370 (GA-A-13531) STATUS OF SAFETY-RELATED QUALIFICATION AND DESIGN VERIFICATION AND SUPPORT PROGRAMS IN SUPPORT OF HTGR PSARs. Biannual Report for Period Ending January 31, 1975. Tully, G. R. Jr.; Stiehl, G. L. Jr. (General Atomic Co., San Diego, Calif. (USA)). 25 Jul 1975. vp. (GA-LTR-102). General Atomic Co., San Diego, CA.

Programs reported are core seismic studies, core support posts, primary coolant moisture monitor, moisture monitor compressor, control rod system, orifice and drive mechanism, reserve shutdown system, main loop coolant shutoff valve, auxiliary loop coolant shutoff valve, core auxiliary heat exchanger, auxiliary loop coolant circulator assembly, auxiliary loop coolant circulator motor speed controls, PPS electronic modules and main loop helium circulator. (DG)

25371 (GEAP-14038-1) ADVANCED SAFETY ANALYSIS. First Quarterly Report, July–November 1974. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Nov 1974. Contract AT(04-3)-893. 76p. Dep. NTIS $5.45.

LMFBR safety-related studies are described in the areas of reactor shutdown system reliability, inherently safe core design, fuel rod failure mechanisms, and engineering analysis of post-accident heat removal. (DG)

25372 (GEAP-20936) BLOWDOWN HEAT TRANSFER REVIEW OF RECENT RESULTS. Sutherland, W. A. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Jul 1975. Contract AT(04-3)-189. 24p. Dep. NTIS $4.00.

The BWR Blowdown Heat Transfer Program is an experimental investigation of BWR system performance and response characteristics under loss-of-coolant accident (LOCA) conditions. Since this is not possible with an actual reactor facility, a scaled test apparatus is used which has system characteristics similar to the reactor. The performance data provide an in-depth understanding of the hydrodynamic and thermodynamic behavior of the LOCA phenomena, such as internal mass distribution, break flow rate and enthalpy, void formation, and core heat transfer mechanisms. These results are being used to verify phenomenological models and computer methods and identify areas where analytical models can be improved. Some of the current findings are summarized. (auth)

25373 (INIS-mf-1731) THE ENVIRONMENT OF NUCLEAR STATIONS IN ENGLAND AND WALES. Williamson, P. (Central Electricity Generating Board, London (UK)). 1973. 16p. INIS.

From 17th Nuclear Congress of Rome, Nuclear Energy and the Environment; Rome, Italy (23 Mar 1972).

The reasons for siting nearly all the first generation of nuclear power stations on the coast are reviewed. Partial relaxation of the remote-siting policy in relation to the third and fourth nuclear stations with advanced gas-cooled reactors (AGR) is discussed and their population characteristics are compared with contemporary European stations. The tidal environment of England and Wales is described and recognition is taken of this in the siting and design of coastal nuclear stations, to ensure that the warm water discharge does not cause adverse environmental effects. The control and discharge of radioactive substances

and the associated environmental monitoring program are discussed. The paper illustrates the care taken to avoid encroaching unnecessarily on those parts of the coastline which are specially prized for amenity and recreational purposes, and discusses some steps which can be taken to make power stations as acceptable as possible to the public. The paper concludes that in future British power stations will be predominantly nuclear. Relaxation of the original remote-siting policy has reduced the visual effects on rural landscapes but, of course, the environmental problems of heated and radioactive discharges remain. Ten years of operational experience with nuclear stations, coupled with the demonstrable independence of the regulatory authorities, has earned the acceptance of the British public and this possibly explains the absence of the sort of opposition which has recently become endemic elsewhere. (auth)

25374 (IRS-W-14 (4-1975)) DESIGN OF NUCLEAR INSTALLATIONS AGAINST EXTERNAL EFFECTS. Calculation of the Force-time Pattern in the Impact of Deformable Projectiles on a Rigid Wall. Drittler, K.; Gruner, P. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Apr 1975. 49p. (In German). Dep. NTIS (US Sales Only) $5.50.

A numerical method is presented which allows for the calculation of the total force acting upon a building during impact of a projectile. The structural part to be hit by the projectile is assumed to be rigid; its surface is perpendicular to the direction of impact. Flight trajectory and projectile axis coincide. Variations of geometric and material properties across the projectile axis are replaced by proper average values. The method is tailored to safety considerations. A parametric study of the force resulting from impact of a fast flying military aircraft is discussed. The velocity prior to the impact is 215 m/s. It is shown that for safety considerations a simplified function between force and time can be established. (auth)

25375 (KR-152) RASMUSSEN REPORT RE-REVIEWED. A Critique of "Preliminary Review of the AEC Reactor Safety Study" Prepared by the Union of Concerned Scientists, Sierra Club Joint Review Committee, Nov. 1974. Doederlein, J. M. (Institutt for Atomenergi, Kjeller (Norway)). Apr 1975. 41p. Dep. NTIS (US Sales Only) $5.25.

The Joint Review Committee of the Sierra Club and the Union of Concerned Scientists has given a review (called UCS) of the draft report WASH-1400 (called RSS) on the Reactor Safety Study directed by N. C. Rasmussen and operated under the general charter of the then US Atomic Energy Commission. This report contains a general critique of the UCS. It is shown that the general method used in UCS to reevaluate the reactor accident consequences as calculated by RSS, is based on invalid assumptions. It is also shown that the UCS criticisms of RSS risk assessment methodology are partly based on invalid assumptions. Also given is a detailed commentary on statements of UCS which the author considers erroneous and/or misleading. (auth)

25376 (NEDO-20355) EFFECT OF A LARGE BUNDLE FLOW AREA RESTRICTION ON THE BWR EMERGENCY CORE COOLING SYSTEM EFFECTIVENESS. Leonard, J. E.; Duncan, J. D. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Apr 1974. 63p. General Electric Co., San Jose, CA.

A description is given of the conditions and results of an experimental combined spray cooling and bottom flooding test (simulating spray cooling and reflooding due to accumulation in a reactor) on a full-scale, simulated BWR 7X7 Zircaloy-clad fuel bundle with exaggerated mechanical blockage at its midplane. The experimental temperature data were compared with calculated values from the General Electric Core Heatup Model. The oxidation data were compared with previous data and the current cladding embrittlement criterion of 10CFR50 Appendix K. The following conclusions were reached: (1) there is effective cooling in the region of artificially induced blockage, both above and below the plane of blockage, (2) sixty percent cross-sectional blockage does not hold up or divert the passage of the cooling medium, and (3) the systematic, concentrated rod bowing caused by the unique test conditions results in a predictable degradation of heat transfer at the elevation of maximum bowing. (auth)

25377 (ORNL-TM-4914(Vol.1)) QUARTERLY PROGRESS REPORT ON REACTOR SAFETY PROGRAMS SPONSORED BY THE NRC DIVISION OF REACTOR SAFETY RESEARCH FOR JANUARY-MARCH 1975. I. Light-Water-Reactor Safety. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 117p. Dep. NTIS $5.45.

Progress is reported in the following areas of study: blowdown heat transfer; fission product beta and gamma energy release; and zirconium-water oxidation kinetics. Operations at the Nuclear Safety Information Center are reviewed. The multirod burst tests, LWR fuel fission product release studies, and zircaloy cladding creepdown and collapse investigations are described. (DCC)

25378 (ORNL-TM-4985) LISTS OF ENVIRONMENTAL STATEMENTS PROJECTS. Buskirk, B. A.; Spiewak, A. R. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 44p. Dep. NTIS $5.25.

The document is a collection of five lists of the Environmental Statements Projects related to nuclear power reactors, consumer products in which by-product radionuclides may be used, ERDA facilities, and, for the Department of Housing and Urban Development, Modular Integrated Utilities Systems. The lists are arranged by (1) Project name, (2) Project docket number, (3) NRC Environmental Project Manager, (4) ORNL Task Group Leader, and (5) ORNL editor. In each list, the first issue date listed for each project is the issue date of its Draft Environmental Statement (DES), and the second issue date is that of the Final Environmental Statement (FES). The lists will be updated as the Environmental Statements Project continues. (auth)

25379 (ORNL-TM-5053) MONTHLY HIGHLIGHTS FOR OFFICE OF NUCLEAR REGULATORY RESEARCH PROGRAMS AT OAK RIDGE NATIONAL LABORATORY. Fee, G. G. (Comp.). (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 37p. Dep. NTIS $4.00.

Technical highlights and cost/budget data are presented for the following programs: heavy section steel technology, fission product beta and gamma energy release, LOCA release from LWR fuel, multirod burst tests, Nuclear Safety Information Center, PWR blowdown heat transfer-separate effects, zircaloy fuel cladding collapse studies, zirconium metal-water oxidation kinetics, transient release from LMFBR fuel, HTGR safety analysis and research, and design criteria for piping and nozzles. (DG)

25380 (ORNL-tr-4003) EXPERIENCE IN OPERATION OF PHENIX WITH REGARD TO SHIELDING. Goddet, J.; Peyresblanques, H.; Galissian, F.; Meffre, P. 1975. Translation of French Report. (CONF-750411-10). 6p. Dep. NTIS $4.00.

From European nuclear conference; Paris, France (21 Apr 1975).

A description is given of studies to determine the operational hazards at the Phenix reactor due to radioactivity and to sodium fires and sodium-water reactions. It is concluded that the operation of Phenix during the first year of full-power production did not indicate any appreciable problems for operating personnel or for the environment. (DG)

25381 (ORO-4313-11) MOLTEN MATERIAL-COOLANT INTERACTION AND PLUTONIUM SOURCE IN LMFBR ACCIDENT ANALYSIS. Eleventh and Twelfth Quarterly Reports for the Period 1 July 1974--31 December 1974. (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). Apr 1975. Contract AT(40-1)-4313. 87p. (ORO-4313-12; NE-3949-111-75; NE-3949-112-75).

An analytical model was developed for estimating bounding values of fuel-vapor generation and fuel-expansion work in an LMFBR core-disruptive accident. The time-dependent hydrodynamic expansion of fuel in spherical geometry is calculated by the model which was programmed as the FEXPAN code on the CDC-6400 computer. A calculation using the model was made for a specified core-disruptive accident for FFTF. For a 100 $/sec, sodium-out, FFTF disassembly followed by expansion without fuel mixing, the FEXPAN calculations indicated that approximately 9 percent of the fuel would be vaporized and 70 MW-sec of work would be done when the sodium column impacts the cover (at approximately 22 msec after disassembly) and that the spatial pressure distribution in the fuel bubble would become uniform between 4 and 10 msec after disassembly. 10 references. (auth)

25382 (SAND-74-0382) CORE-MELTDOWN EXPERIMENTAL REVIEW. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1975. Contract AT(29-1)-789. 472p. Dep. NTIS $13.60.

The results of a study of the experimental evidence having a bearing on hypothetical core meltdowns in light-water reactors are presented. The first objective of the study was to obtain a compendium of the experimental evidence applicable to the analysis of a hypothetical core meltdown. Literature from the nuclear power field and from other scientific disciplines and industrial sources was reviewed. Investigators and other persons knowledgeable in the subject were interviewed. A second objective was to determine what data are required and to determine the adequacy of existing data. In core-meltdown studies only land-based plants have been examined. A third, and final, task of this study was to examine offshore plants to determine applicability of onshore plant analysis to particular areas therein and to determine what information peculiar to meltdown accidents in offshore plants was needed. (auth)

25383 (STI/PUB-384) SITING OF NUCLEAR FACILITIES. Proceedings of a Symposium Held in Vienna, 9-13 December

1974. Proceedings Series. (International Atomic Energy Agency, Vienna (Austria)). 1975. 677p. (In several languages). (CONF-741210-). IAEA $39.00.

Thirty-eight papers are presented under the following topic headings: national siting criteria and practices, siting and environment, siting and reprocessing plants, and new approaches to siting policies. Separate abstracts were prepared for all papers. (DG)

For abstracts of individual papers see: 24221–24223, 24444, and 25400–25433.

25384 (UCLA-ENG-7472) POST-ACCIDENT CORE RETENTION FOR LMFBR'S. 2. Technical Report, 1 July 1973--30 June 1974. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Sep 1974. Contract AT(04-3)-34. 149p. (UCLA-34P203-1B). Dep. NTIS $10.50.

This report describes work performed at UCLA on Post Accident Heat Removal for the period July 1973 to July 1974. The work includes a preliminary identification of sequences of events that could lead to a completely disassembled core and analysis of several in-vessel processes relevant to establishing whether or not containment can be achieved. Preliminary observations on the dry-out of debris beds are reported. The effects of both stabilizing temperature gradients and thermal radiation on increases in the downward heat transfer from a molten layer of UO_2 are found to be significant. Boiling of the molten layer is considered and the existing experimental data is found to be inadequate. Predictions of heat transfer from a downward facing surface to a low Prandtl number fluid are not available. Recommendations for future work are made. The effects of disturbances on a quiescent molten layer are presented. A simple fast method of estimating recriticality is given and an estimate of possible ramp rates is made. Areas of uncertainty requiring further work are identified. (auth)

25385 (UCLA-ENG-7545) SAFETY RESEARCH NEEDS FOR CARBIDE AND NITRIDE FUELED LMFBR's. Final Report. Kastenberg, W. E. (California Univ., Los Angeles (USA). Dept. of Energy and Kinetics). Jun 1975. Contract AT(04-3)-34. 67p. Dep. NTIS $6.75.

Results are summarized for studies conducted in the following areas: (1) core and primary system designs for carbide and nitride fuels, (2) carbide and nitride fuel element irradiation behavior, (3) reactor behavior under postulated accident conditions, (4) analytical methods of accident analysis to identify major gaps in existing models and data, and (5) post accident heat removal. Recommendations are made for further studies. (DG)

25386 (UCRL-51718) FAULT TREE ANALYSIS OF THE LPTR SCRAM SYSTEM. Mortensen, W. K.; Savage, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Dec 1974. Contract W-7405-Eng-48. 45p. Dep. NTIS $4.00.

The protective control or scram system of the Livermore Pool Type Reactor (LPTR) has been subjected to fault tree analysis to determine its vulnerability to various component failures or other untoward events both credible and incredible. This report describes the analysis and discusses the results. The principal result is that no single component failure nor any single credible event can result in a failure of the reactor to scram when a scram is required. (auth)

25387 (WANL-TME-545) STATUS OF WANL EXCURSION ANALYSIS PROGRAM. Call, D. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1963. 24p. Dep. NTIS $4.25.

Declassified 11 Sep 1973.

The WANL excursion analysis program is based on two computer programs (RTS and RAC) developed by Los Alamos Scientific Laboratory. WANL has made certain modifications and additions to these programs where necessary so as to treat special problems of interest. Each program, due to inherent limitations, is applicable only over certain restricted ranges of reactivity which overlap for the NERVA reactor. The possible types of accidents can be divided into three classes distinguished by the manner of reactivity insertion: Abnormal Control Rod Motion; Core Deformation; or Water Immersion and Hydrogen Propellant Flooding. (auth)

25388 (WANL-TME-713) NRX-A CORE COMPACTION PROGRAM. Bodenschatz, C. A.; Meyer, L. F.; Roll, J. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Mar 1964. 35p. Dep. NTIS $4.75.

Declassified 12 Sep 1975.

As a result of pre-launch accident or a post-launch malfunction, the NERVA reactor could impact with the ground. This impact could cause fragmenting and compaction of the fuel, resulting in a nuclear excursion. However if the pressure vessel were to split, insufficient compaction and escape of fragments would prevent this excursion. Therefore, even if there is sufficient fragmenting of the core, the reactor will not go critical. It is for the purpose of evaluating this situation that core compaction experiments have been proposed. The experiments would consist of static tests at WANL and 1/9th and 1/3rd scale sled tests at Sandia Base, New Mexico. Impact velocities of 100 and 150 ft/sec are planned; these velocities correspond to drop heights of 215 and 325 feet. (auth)

25389 (WANL-TME-735) WANL NUCLEAR EXCURSION ANALYSIS PROGRAM. Call, D.; Cleary, J.; Roidt, M.; Roll, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Apr 1964. 20p. Dep. NTIS $4.00.

Declassified 11 Sep 1973.

The ultimate objective of the WANL excursion analysis program is to develop a generalized analytical model which predicts the biological hazards resulting from any conceivable accident involving a nuclear excursion occurring at any phase of the NERVA program. These hazards will arise primarily from the exposure of an involved population to radioactive fission products. The exposure can be effected either through ingestion and inhalation of radioactive core particles or downwind "cloud" doses as a result of fission product gases which have diffused from the core. A generalized analytical model must incorporate nucleonics, hydrodynamics, thermodynamics with transient heat flow, dynamics, and the fission product inventory with diffusion. WANL has developed and is developing several computer programs appropriate to the problem areas defined above. Eventually, they will be combined and integrated into a generalized excursion analysis program applicable to any conceivable accident. A description of these programs is given. (auth)

25390 (WANL-TME-1126(Suppl.1)) NRX/EST SAFETY EVALUATION REPORT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Nov 1965. 35p. Dep. NTIS $4.75.

Since the issue of WANL-TME-1126, "NRX/EST Safety Evaluation Report" and subsequent review, several items covered by the report have changed. Comments by those reviewing the document also indicated that additional detail would be advantageous in some areas. Material is presented to update, expand and correct the NRX/EST -Safety Evaluation Report and to supply additional information requested. (auth)

25391 (WCAP-8219-A) FUEL DENSIFICATION EXPERIMENTAL RESULTS AND MODEL FOR REACTOR APPLICATION. Hellman, J. M. (ed.). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Energy Systems Div.). Mar 1975. Westinghouse Electric Corp., Pittsburgh, PA.

Westinghouse has developed new Fuel Densification and Power Spike Models and some changes for DNB evaluation based on the performance of fuel in operating reactors and associated experimental results. The data input for these models included measurements of fuel stack height shrinkage and interpellet gap distributions from incore flux traces, gamma scanning and destructive testing of irradiated fuel rods, incore measurements of neutron flux spikes from interpellet gaps of known size, and DNB testing of simulated fuel rods with axial power spikes. The experimental instrumentation, data collection and analysis, and the derivation and application of the models are described. (auth)

25392 (WCAP-8473-A) WESTINGHOUSE ECCS EVALUATION MODEL: SUPPLEMENTARY INFORMATION. Bordelon, F. M.; Buterbaugh, T. L.; Johnson, W. J.; Maul, B. A.; Yang, J. W.; Kelly, R. D.; Kopelic, S. D.; Massie, H. W. Jr.; Zordan, T. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Apr 1975. 520p. Westinghouse Electric Corp., Pittsburgh, PA.

Modifications and supplementary information to the Westinghouse ECCS evaluation model are presented. (JWR)

25393 (XN-75-41(Vol. 1)) EXXON NUCLEAR COMPANY WREM-BASED GENERIC PWR ECCS EVALUATION MODEL. Volume I. Model Definition. (Exxon Nuclear Co., Richland, Wash. (USA)). 25 Jul 1975. 85p. EXXON Nuclear Company, Inc., Richland, WA.

The Exxon PWR-ECCS model is described. Modifications made to the NRC Water Reactor Evaluation Model so that the Exxon model conforms to appendix K criteria of 10 CFR Part 50 are discussed. (JWR)

25394 (XN-75-41(Vol. 2)) EXXON NUCLEAR COMPANY WREM-BASED GENERIC PWR ECCS EVALUATION MODEL. Volume II. Model Justification. (Exxon Nuclear Co., Richland, Wash. (USA)). 1 Aug 1975. 176p. EXXON Nuclear Company, Inc., Richland, WA.

The conformance of the Exxon generic PWR-ECCS evaluation model to the requirements of Appendix K criteria of 10 CFR Part 50 is described. (JWR)

25395 NUCLEAR FUEL PIN CONTROLLED FAILURE DEVICE. Schlenker, L. D. (to U. S. Energy Research and Development Administration). US Patent 3,886,037. G21c3/06. 27 May 1975. Filed Date 17 Aug 1973. 7p.

PAT-APPL-389,287.

Each fuel pin of a fuel assembly for a water-cooled nuclear reactor is provided with means for rupturing the cladding tube at a predetermined location if an abnormal increase in pressure of the gases present occurs due to a loss-of-coolant accident. Preferably all such rupture means are oriented to minimize the hydraulic resistance to the flow of emergency core coolant such as all rupture means pointing in the same direction. Rupture means may be disposed at different elevations in adjacent fuel pins and, further, fuel pins may be provided with two or more rupture means, one of which is in the upper portion of the fuel pin. Rupture means are mechanical as by providing a locally weakened condition of a controlled nature in the cladding. (Official Gazette)

25396 CORRELATION OF REWETTING DATA. Piggott, B.D.G.; Porthouse, D.T.C. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nucl. Eng. Des.; 32: No. 2, 171-181(1975).

Following a loss-of-coolant accident in a water reactor the fuel pins dry out and overheat and it becomes necessary to rewet them to restore normal temperatures. A thermal conduction analysis of rewetting is presented in which it is shown that the heat transfer coefficient associated with rewetting may be taken as an arbitrary function of surface temperature, rather than a constant, without changing the dependency of rewetting velocity on the other variables. The available rewetting data at both atmospheric and elevated pressure have been analyzed using an existing theoretical model. Taking the effective heat transfer coefficient as proportional to the product of mass flow rate and inlet subcooling a data fit has been achieved to within a factor of two. Expressions are given which predict rewetting rates for a wide range of pressures, wall temperatures, subcoolings, clad materials and geometries. (auth)

25397 QUENCHING OF IRRADIATED FUEL PINS. Piggott, B.D.G.; Duffey, R. B. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nucl. Eng. Des.; 32: No. 2, 182-190(1975).

The results of falling film rewetting experiments on two types of irradiated fuel pin and on a complementary range of tubes and heaters are presented. Preliminary measurements of rewetting rate in bottom flooding are presented and a brief comparison is made between falling film and bottom flooding rewetting, including the effects of surface finish. It is demonstrated that fuel pin rewetting behavior is broadly consistent with that for tubes and heaters and that there are no large systematic effects of irradiation. Surface finish is shown to have an important influence on the falling film rewetting rate and could have influenced the fuel pin behavior. (auth)

25398 REVIEW OF SPRAY-COOLING AND BOTTOM-FLOODING WORK FOR LWR CORES. Sawan, M. E.; Carbon, M. W. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Nucl. Eng. Des.; 32: No. 2, 191-207(1975).

Rewetting or the re-establishment of water films on the hot, fuel rod surfaces is of fundamental importance following a loss-of-coolant accident in a water cooled reactor. Two techniques are used: rewetting by a falling film of water (top spray) and rewetting by an upflow of water (bottom flooding). Considerable theoretical and experimental work has been done to investigate the effects of different operating parameters on these techniques, and that work is summarized. (auth)

25399 HYBRID METHOD, A NEW ACCURATE COMPUTATION METHOD FOR TRANSIENT TEMPERATURE DISTRIBUTIONS IN FUEL RODS. Nijsing, R.; Eifler, W. (SEE CODE-1910825 Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Nucl. Eng. Des.; 32: No. 2, 208-220(1975).

A new computation method is presented for solving problems of transient heat conduction in nuclear fuel rods. In this method the fuel rod cross section is divided into a number of concentric annular elements to which heat balances are applied. The resulting system of linear differential equations with time as the independent variable is solved analytically using a matrix method. The method is illustrated for a variety of examples of practical interest. Salient features of the new method are great accuracy and high speed of computation. (auth)

25400 REGIONAL APPROACHES TO POWER PLANT SITING IN THE UNITED STATES OF AMERICA. DiNunno, J. J. (NUS Corp., Rockville, MD). pp 3-41 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

The selection and evaluation of sites for power plants in the United States of America have become increasingly difficult in recent years as pressures from various societal segments have resulted in governmental restraints on selection and burning of fossil fuels, methods of heat dissipation, acquisition of transmission rights of way, and on environmental impact of industrialization in general. New legislation at both Federal and state levels has been enacted that influences power plant siting. In addition to environmental requirements that must be satisfied, implementing procedures require documented justification for sites chosen and public disclosure of the basis for selection. Some states have consolidated their regulatory activities in the power plant siting area to provide for a more unified approach to these problems. Although nuclear plants have by far the most rigorous requirements for documentation of site selection and plant design, the application of the same general philosophies to fossil plants has been made in several states and can be anticipated elsewhere. Individual site-related investigations have not so much changed in basics as they have been enlarged in scope. Whereas in the past the search for siting alternatives was frequently confined to a utility's service area, the additional siting constraints represented in environmental laws, the economies of size of nuclear power plants, and the sharing of plant capacities among utilities have contributed to a widening of the search area. Several states have assumed the responsibility for site search and investigation and their efforts extend state-wide. Applications of regional approaches to power plant siting in the United States of America are discussed using case studies made by an engineering/environmental consulting firm. The universality of the approach is indicated, leaving to national policies and goals the importance of values assigned to the basic siting factors. (auth)

25401 SITING: MEANS BY WHICH NUCLEAR FACILITIES ARE INTEGRATED INTO A CANADIAN COMMUNITY. Beare, J. W.; Duncan, R. M (Atomic Energy Control Board of Canada, Ottawa). pp 43-66 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

In Canada, the Atomic Energy Control Board considers the siting implications of a number of different kinds of nuclear facilities. Its overall objective is to ensure that nuclear facilities are sited, designed, constructed and operated so that the level of risk to the health and safety of people and any adverse impact on the environment are acceptable. This requires in part the establishment of siting criteria, which involves the balancing of safety, environmental, sociological and economic factors. The application of these criteria is performed in the light of the need to integrate the plant with its surroundings in a manner acceptable to all those involved, particularly the public. The implications are discussed of siting two of the major types of facilities in Canada: nuclear power plants and heavy-water production plants, the former presenting radiological hazards, the latter being of concern due to the severe chemical toxicity of one of the process fluids, the similarities and differences in safety standards and regulatory approach for the two facility types are indicated, and the site approval procedure, the intergovernmental relationships required for efficient regulation, and the current status of public participation are discussed. (auth)

25402 SAFETY POLICY FOR SITING NUCLEAR POWER STATIONS IN THE FEDERAL REPUBLIC OF GERMANY. Bachus, K. P.; Schnurer, H. (Federal Ministry of the Interior, Bonn). pp 67-78 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

Sites for nuclear power stations must meet various requirements related, e.g., to economy, environmental protection, nuclear safety or regional planning. So far, new sites in the Federal Republic of Germany have been selected by the utilities and have to be licensed by different responsible authorities at federal, state, or lower level. There are serious problems in selecting suitable sites in such a densely populated country. The Federal Government's energy program, however, requires up to thirty new sites for large nuclear power plants within the next five or six years. To avoid delays in licensing procedure and at the same time to select optimal sites from limited possibilities, a long-term policy of making provisions for sites is under development. This will include (a) an optimal site preselection process which takes relevant aspects of sites into account, and (b) a process to guarantee a later license as far as possible. It is intended to develop an abundant stock of sites from which sites can be chosen as necessary, combined with a standardized nuclear

power station concept. This will allow a construction permit to be issued much sooner than at present. As a tool for facilitating site planning, safety-orientated site evaluation data are under development. It is not intended to establish any stringent licensing criteria but to offer site evaluation data which will indicate for each safety-related site property the trend which site planning should follow. This will be achieved by three categories of data for judging individual site properties. Due to the far-reaching actual or potential influence of a nuclear power station, certain information and co-ordination mechanisms are needed in order to harmonize site planning in frontier regions. (auth)

25403 CRITERIA FOR THE SITING OF RESEARCH CENTERS, POWER PLANTS, AND FUEL-REPROCESSING FACILITIES IN THE USSR. Dergachev, N. P. (State Committee for Utilization of Atomic Energy, Moscow). pp 79-84 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975). (In Russian)

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

Given the unavoidable necessity of releasing some radioactive isotopes into the atmosphere and open water-bodies, nuclear facilities represent a potential hazard to the environment and the population. Problems are considered which are associated with keeping the gaseous and liquid radioactive wastes released to the external environment at permissible levels by means of a comprehensive set of measures which rely not only on the recovery and purification of wastes but also on correct siting of facilities, so as to ensure the safety of the population both in normal operation and in emergency situations. The establishment of a health protection zone around a nuclear facility reduces to an insignificant level the radiation hazard to the population living in the vicinity. (auth)

25404 SITING OF NUCLEAR POWER STATIONS IN INDIA. Venkatesh, L. (Department of Atomic Energy, Bombay); Sarma, T. P. pp 85-98 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

In India, a National Committee appointed by the Government has developed certain guidelines for the principal criteria for evaluation of sites in relation to Indian conditions, taking into account the available experience in the country in the construction and operation (as appropriate) of the initial stations (at Tarapur, Ranapratapsagar and Kalpakkam) as well as experience abroad. The philosophy pursued with regard to the protection of the environment from radioactive pollution arising from the release of wastes from the station is one of containment of wastes rather than of dilution and disposal, which would enable utilization of the environment without undue restriction. Applying the criteria thus evolved, the National Committee has examined a number of sites both coastal and inland and generally situated in areas far away from coalfields, keeping in mind the design requirements of Candu-type stations, and has identified some of them as suitable on techno-economic grounds. These sites, spread over a large part of the country, will remain suitable so long as the facilities and the environmental conditions now obtaining there are preserved. It may be some years before all the selected sites are utilized. If the site conditions change in the meantime, fresh evaluation would be necessary. A description is given of some of the principal criteria and guidelines evolved and the present effort for selection of sites for future stations, together with the problems faced and the experience gained. (auth)

25405 NUCLEAR SAFETY CRITERIA APPLIED IN SITE SELECTION: THE PRACTICE IN FRANCE. Candes, P.; Aussourd, P. (Service Central de Surete des Installations Nucleaires, Paris). pp 99-113 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975). (In French)

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

In France, the safety of nuclear facilities is the responsibility of the Ministry for Industry and Research (Central Department for the Safety of Nuclear Facilities). A description is given of the conception and contents of the site studies which are included in a safety report with the object of obtaining authorization to go ahead with work on the establishment of a facility. The conception is governed by the following two considerations: (a) the site is a place where natural elements and living organisms occur and which is characterized by the permanent presence of the human factor, while the proposed nuclear facility will—like any industrial facility—present risks and have an impact on the site, particularly through the discharge of radioactive effluents and potential consequences of a nuclear accident; (b) the site exercises an influence—in fact, it even imposes constraints—on the nuclear facility. The site study as submitted by the operators to the authorities responsible for the safety evaluation traditionally consists of six sections, covering: (I) description and history of the site; (II) meteorological conditions; (III) hydrology of the area; (IV) geological and seismological conditions; (V) ecological factors; (VI) natural and/or previous radioactivity at the site. These six sections contain the data which serve as a basis for applying the two considerations spelled out above. However, the two corresponding directions of study and analysis do not settle the fundamental problem of the distribution of the population around the site. Methods for dealing with this problem are suggested; they take into account the efforts made so far at the international level. The authors consider that limiting criteria should not be based solely on the radioactive effluent discharges associated with normal operation but on the radioactivity releases associated with accidents. The methods proposed constitute a gradual approach to the solution of this problem. (auth)

25406 TERRITORIAL AND ENGINEERING REQUIREMENTS IN NUCLEAR STATION SITING. Dellarciprete, C.; Morelli, V. (Ente Nazionale per l'Energia Elettrica, Rome). pp 115-132 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

In view of the very large number of factors to be considered in siting a nuclear station, it is necessary to proceed through a succession of selections carried out by introducing discriminating factors to simplify and rationalize the work. The first selection is made on the basis of a number of factors capable of characterizing the territory in general. Then, among the prospective sites, a further selection is made, taking engineering requirements into account. A survey is made of the primary characteristics of the territory and engineering requirements affecting the choice. A scheme is proposed for collection and examination of primary territorial data; a functional diagram is then presented to illustrate the activities to be carried out to ascertain that the site is suitable also from the engineering standpoint. (auth)

25407 NUCLEAR POWER STATION SITING EXPERIENCE IN THE UNITED KINGDOM: PAST AND PRESENT AND PROPOSALS FOR THE FUTURE. Haire, T. P.; Usher, E. F. F. W. (Central Electricity Generating Board, London). pp 143-155 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

Foremost of the many factors in site selection considerations are population distribution, cooling-water availability, and amenity. Others are safety of potable water sources, geological stability, and the risk of external hazards. Where cooling-water supplies are a limiting factor, the choice of reactor system is of major importance. To determine as early as possible the effect a station might have on its environment, desk studies, visual surveys, and wind-tunnel tests are carried out. The Central Electricity Generating Board places great importance on obtaining the fullest degree of acceptance by the public for its nuclear stations and ensures that full consultation is provided with the relevant authorities at all stages of power-station development. It also provides public exhibitions, public meetings and liaison with the local inhabitants. Recruitment of station staff where possible from the immediate area of the station and formation of sports and social clubs are two of the practical steps which help to integrate the station into the local community. The current energy crisis has reinforced the need for a substantial nuclear programme, so possible ways of further reducing the impact of nuclear stations on the environment are being considered. It is concluded that sufficient nuclear sites can be provided for future needs but that continuing effort will be required to ensure public acceptance. (auth)

25408 SITING CONSIDERATIONS FOR NUCLEAR FACILITIES IN PAKISTAN. Nasim, M.; Hasnain, S. A. (Karachi Nuclear Power Plant, Pakistan). pp 157-164 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

With a growing nuclear power program in Pakistan, the siting of reactors and other facilities has become important from safety and economic viewpoints. A review is given of the considerations in site selection of the 137-MW(e) Karachi Nuclear Power Plant and other reactors. The location of a complex of nuclear power plants to be built in the next decade has been decided on grounds of availability of cooling water, distance from load centers, and acceptable meteorological and geophysical factors. (auth)

25409 CRITERIA ADOPTED IN SELECTING THE SITES FOR THREE NUCLEAR POWER STATIONS IN SPAIN. Perez

del Moral, C. (Junta de Energia Nuclear, Madrid). pp 165-174 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975). (In Spanish)

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

An outline is presented of a demographic criterion applied in Spain in evaluating a site. It shows how the criterion was applied to the sites chosen for three nuclear power stations under construction in Spain which use pressurized-water reactors with a unit power of 900-1000 MW(e). Each of the sites has its own particular problems: a knot of population close by, high population density beginning only 2 km away, and a busy railway line crossing the site. These site characteristics naturally affect the minimum requirements for containment and associated technical safeguards that must be fulfilled to meet the criterion referred to above. (auth)

25410 ARGENTINIAN EXPERIENCE IN SELECTING SITES FOR NUCLEAR POWER STATIONS. Csik, B. J. (Comision Nacional de Energia Atomica, Buenos Aires). pp 175-182 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975). (In Spanish)

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

One nuclear power station is in operation in the Republic of Argentina, a second is under construction, and the decision to build a third has been taken. According to existing plans, about ten nuclear power stations should go into operation during the next decade. An analysis is presented of the experience acquired in selecting sites for the first units, commenting on the criteria and methods applied, the studies that were carried out, the specific problems encountered and the solutions adopted, as well as on the question of acceptance of the chosen sites by the public. The current program of selection and study of sites for future nuclear power stations is described. (auth)

25411 SITES OF LIGHT-WATER REACTOR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Kohler, H. A. G. (Kraftwerk Union AG, Frankfurt am Main). pp 183-215 International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

The nuclear power plant site requirements formulated for environmental protection in the Federal Republic of Germany allow nuclear power plants to be built at any site provided these requirements are duly taken into account in preparing and monitoring the site and in the design of the proposed power plant. After a brief discussion of site planning, site selection and licensing procedures, a report is presented on the interpretations placed by expert advisers and by the licensing authorities, in the past and at present, on the criteria, rules, and guidelines used in the licensing procedures relating to proposed sites for power plants with light-water reactors. (auth)

25412 INTEGRATED APPROACH TO SITE SELECTION FOR NUCLEAR POWER PLANTS. Hassan, E. M. A. (Atomic Energy Establishment, Cairo). pp 227-245 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

A method of analysing and evaluating the large number of factors influencing site selection is proposed which can interrelate these factors and associated problems in an integrated way and at the same time establish a technique for site evaluation. The objective is to develop an integrated program that illustrates the complexity and dynamic interrelationships of the various factors to develop an improved understanding of the functions and objectives of siting nuclear power plants and would aim finally at the development of an effective procedure and technique for site evaluation and/or comparative evaluation for making rational site-selection decisions. (auth)

25413 CRITERION FOR NUCLEAR SAFETY ASSESSMENT. Gonzalez, A. J. (Comision Nacional de Energia Atomica, Buenos Aires). pp 265-281 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975). (In Spanish)

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

The criterion presented has been developed extrapolating to the nuclear safety field the ICRP basic concepts and philosophies on radiological protection. The criterion postulates the use of a hyperbolic control curve basically similar to the one proposed by F. R. Farmer for probabilistic evaluations. The postulated control curve differs from Farmer's curve in both application range and characteristics of its mathematical function. A range of application is proposed from a minimum severity level (the ^{131}I authorized discharge limit) to a severity level as large as the reactor's ^{131}I inventory. The exponent value of the proposed hyperbolic function is variable with both the siting and ^{131}I inventory of the reactor, and it also changes with the extrapolated radioprotection concept, as considered. The methodology to evaluate the control curve exponent is also presented. Three evaluation methods are described with the following objectives: (a) to limit expectation of individual dose in order to limit individual risk; (b) to limit expectation of collective dose in order to limit population detriment to justifiable levels; and (c) to optimize the installation in order to obtain a dose expectation as low as readily achievable. Three figures present the control curve exponent plotted versus dosimetric factor for 10^6, 10^7 and 10^8 Ci of ^{131}I inventories. The following conclusions can be deduced: (a) the expectation of individual dose changes very little with different inventories; (b) in sites where the collective dose per unit of activity released is high, only large reactors are justifiable; and (c) optimization analysis is generally less restrictive than the justification one. Finally, a criterion is suggested for limitation of collective dose commitment, to limit the future dose rate arising from accidents that could occur at present. (auth)

25414 SITE SELECTION PROCEDURE FOR NUCLEAR POWER PLANTS IN DENMARK. Hannibal, L. (State Inst. of Radiation Hygiene, Copenhagen); Schultz-Larsen, J. pp 283-298 of Siting of nuclear facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

Although no political decision to introduce nuclear power in Denmark has yet been made, appropriate action has been taken to make land reservations that will be necessary for prospective nuclear power plants. As it is wished to treat the problem on the basis of long-range national planning, an interdepartment committee has been appointed to deal with the matter. The committee includes representatives from a number of ministries, the Danish Atomic Energy Commission, the National Health Service, various government advisers, and the Danish Electricity Council. A description is given of how the committee arrived at the selection of suitable sites in the western part of the country. For a radiological safety assessment of the sites, a number of dose-related parameters were calculated, based on a loss-of-coolant-accident ^{131}I release and the pertinent population distribution. In accordance with the general recommendation by the International Commission on Radiological Protection that, economic and social considerations being taken into account, all doses should be kept as low as reasonably achievable, those sites were selected which had the lower parameter values and which were acceptable from other points of view to the committee. Mention is made of how a radius of 2-3 km was arrived at for an inner zone where very few new dwellings will be permitted, and reference is made to the choice of 10 km for the radius of an outer zone in which the population density will not be allowed to increase significantly. (auth)

25415 RISK AND POPULATION DOSE CALCULATIONS CARRIED OUT IN STUDYING NUCLEAR POWER PLANT SITES NEAR HELSINKI. Tiainen, O. J. A. (Helsinki Electricity Works); Kortelaine, P.; Savolainen, I.; Tarjanne, R. pp 299-306 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

The combined production of electricity and district heat by large nuclear power plants was concluded to be economical in the Helsinki Metropolitan Area. It is also an advantageous alternative method of supplying energy from the point of view of air purity. The alternative sites for a nuclear power plant were compared, including probable population doses caused by energy production and the consequences of radioactive releases due to reactor accidents. The latter comparison is more important in site selection because, in the normal operation of a nuclear power plant in the present stage of engineering, the individual and population doses round the nuclear power plant can be arranged to be well below the latest dose-limit guidelines also in densely populated areas. In analysing the accident consequences, both deterministic and probabilistic analyses were carried out. The probabilistic analysis performed showed that useful information for site selection was obtained even if the release spectrum was simplified. On the other hand, more data are needed for release spectrum before the probabilistic analysis can wholly displace the deterministic site evaluation. (auth)

25416 GENERAL STUDIES OF THE ENVIRONMENT OF NUCLEAR SITES WITH A VIEW TO EVALUATING PROTECTION OF THE POPULATION. Bresson, G.; Coulon, R.; Mechali, D. (CEN, Fontenay-aux-Roses, France). pp 327-333 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975). (In French)

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

Of the tasks facing those responsible for a nuclear plant, that of selecting the site is necessarily of great importance because it determines the impact on the population and on the environment of the release of effluents both during normal operation and as the result of an accident. It is the task of radiological protection specialists, starting in the very first stages of the project and continuing until after commissioning, to make estimates of that impact and of its consequences, in order to supply the essential basic data for rational decision making. Such estimates can take various forms depending on the precision required. The principles developed by international organizations, which are sometimes adopted in national regulations, involve estimating the individual exposure of the critical group, the exposure of the population as a whole, and the radiological consequences of a possible accident. The studies necessary to achieve these objectives are aimed at establishing the characteristics of the environment and of transfers of radioactivity by the collection of existing data and by simulation, as well as the characteristics of the population, in particular its distribution, activities, and habits. These data can be synthesized in a more or less elaborate fashion to determine the limiting radiological capacity on a regional level, to bring to light exclusion criteria or to make a comparison between short-listed sites. (auth)

25417 NUCLEAR POWER STATION SITE SELECTION AND PROTECTION OF THE ENVIRONMENT. Jammet, H. (CEN, Fontenay-aux-Roses, France); Bellin, A.; Lcourly, G.; Beau, M.; Morlat, M. pp 335-347 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975). (In French)

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

In France by the end of the century the installed nuclear capacity will be of the order of 200 GW, which means that about forty sites will be needed. The selection of sites for nuclear power stations is based on a number of diverse considerations. For convenience, the principal factors considered have been classified here into three main groups: general criteria, safety criteria, and radiological protection criteria. The selection of sites also involves political, economic and social aspects of which account is taken in the preliminary studies. Some of the selection criteria can be determined with good precision, some remain subject to more or less subjective estimations and others are of a strictly political character. The authors examine to what extent it is possible to reach as rational an analysis as possible with which to explain and justify the selection of sites. (auth)

25418 SYSTEMS ANALYSIS APPROACH TO NUCLEAR FACILITY SITING. Gros, J. G. (International Institute for Applied Systems Analysis, Laxenburg, Austria); Avenhaus, R.; Linnerooth, J.; Pahner, P. D.; Otway, H. J. pp 387-406 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

An attempt is made to demonstrate an application of the techniques of systems analysis, which have been successful in solving a variety of problems, to nuclear facility siting. Within the framework of an overall regional land-use plan, a methodology for establishing the acceptability of a combination of site and facility is discussed. The consequences (e.g., the energy produced, thermal and chemical discharges, radioactive releases, aesthetic values, etc.) of the site-facility combination are identified and compared with formalized criteria in order to ensure "legal acceptability". Failure of any consequences to satisfy standard requirements results in a feedback channel which works to effect design changes in the facility. When "legal acceptability" has been assured, the project enters the public sector for consideration. The responses of individuals and of various interested groups to the external attributes of the nuclear facility gradually emerge. The criteria by which interest groups judge technological advances reflect both their rational assessment and unconscious motivations. This process operates on individual, group, societal and international levels and may result in two basic feedback loops: one which might act to change regulatory criteria; the other which might influence facility design or site selection. Such reactions and responses on these levels result in a continuing process of confrontation, collaborative interchange and possible resolution in the direction of an acceptable solution. Finally, a Paretian approach to optimizing the site-facility combination is presented for the case where there are several possible combinations of site and facility. A hypothetical example of the latter is given, based upon typical preference functions determined for four interest groups. The research effort of the IIASA Energy Systems Project and the Joint IAEA/IIASA Research Project in the area of nuclear siting is summarized. (auth)

25419 CHOICE OF A METHOD OF EVALUATING CONTAMINATION RESULTING FROM ATMOSPHERIC DISCHARGES FROM A FACILITY DURING NORMAL OPERATION AS A FUNCTION OF ENVIRONMENTAL CHARACTERISTICS. Garnier, A.; Bouville, A. (CEN, Fontenay-aux-Roses, France). pp 417-426 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975). (In French)

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

The contamination resulting from atmospheric discharges from a facility can affect the atmosphere, the soil and agricultural products, and the aquatic environment. Since deposition of atmospheric origin can be deduced directly from the concentration of the elements in the air, the choice of diffusion model is very important. Various theoretical or empirical methods are available for evaluating concentrations resulting from continuous discharges, each offering advantages and disadvantages according to the particular problem. It is desirable for the model to be simple enough to be general and easy to use. At the same time it must be able to allow for the environmental characteristics peculiar to a region or a site. This calls for a more or less detailed study depending on the ultimate aim of the evaluation and the degree of precision required. To determine maximum individual doses, it is sufficient to know the maximum concentrations and their location. On the other hand, the evaluation of collective doses calls for a much more elaborate study and, in the first place, the acquisition of data from which to calculate the mean concentrations in various zones situated in a large radius around the facilities; this radius will itself be determined by the limits of validity of the models. (auth)

25420 IMPACT OF EXTERNAL EVENTS ON SITE EVALUATION: A PROBABILISTIC APPROACH. Jaccarino, E.; Giuliani, P.; Zaffiro, C. (Comitato Nazionale per l'Energia Nucleare, Rome). pp 427-433 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

A probabilistic method is proposed for definition of the reference external events of nuclear sites. The external events taken into account are earthquakes, floods and tornadoes. On the basis of the available historical data for each event it is possible to perform statistical analyses to determine the probability of occurrence on site of events of given characteristics. For earthquakes, the method of analysis takes into consideration both the annual frequency of seismic events in Italy and the probabilistic distribution of areas stricken by each event. For floods, the methods of analysis of hydrological data and the basic criteria for the determination of design events are discussed and the general lines of the hydraulic analysis of a nuclear site are shown. For tornadoes, the statistical analysis has been performed for the events which occurred in Italy during the last 40 years; these events have been classified according to an empirical intensity scale. The probability of each reference event should be a function of the potential radiological damage associated with the particular type of plant which must be installed on the site. Thus the reference event could be chosen such that for the whole of the national territory the risk for safety and environmental protection is the same. (auth)

25421 APPROACH TO SITING NUCLEAR POWER PLANTS: THE RELEVANCE OF EARTHQUAKES, FAULTS, AND DECISION ANALYSIS. Nair, K.; Brogan, G. A.; Cluff, L. S.; Idriss, I. M.; Mao, K. T. (Woodward-Clyde Consultants, Oakland, CA). pp 435-472 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

The regional approach to nuclear power plant siting described identifies candidate sites within the region and ranks these sites by using decision-analysis concepts. The approach uses exclusionary criteria to eliminate areas from consideration and to identify those areas which are most likely to contain candidate sites. These areas are then examined in greater detail to identify candidate sites, and the number of sites under consideration is reduced to a reasonably manageable number, approximately 15. These sites are then ranked using concepts of decision analysis. The exclusionary criteria applied relate primarily to regulatory-agency safety requirements and essential functional requirements. Examples of such criteria include proximity to population centres, presence of active faults, and the availability of cooling water. In many areas of the world, the presence of active faults and potential negative effects of earthquakes are dominant exclusionary criteria. To apply the "active fault" criterion the region must be studied to locate and assess the activity of all potentially active faults. This requires complementary geologic (including geomorphic), historical, seismological,

geodetic and geophysical investigations of the entire region. Site response studies or empirical attenuation correlations can be used to determine the relevant parameters of anticipated shaking from postulated earthquakes, and analytical testing and evaluation can be used to assess the potantial extent of ground failure during an earthquake. After candidate sites are identified, an approach based on decision analysis is used to rank them. This approach uses the preferences and judgements of consumers, utility companies, the government, and other groups concerned with siting and licensing issues in the ranking process. Both subjective and objective factors are processed in a logical manner, as are the monetary and non-monetary factors and achievement of competing environmental and design objectives. (auth)

25422 FINDING A CRITERION FOR SITE EVALUATION BY WEIGHTING RADIOLOGICAL, METEOROLOGICAL, AND DEMOGRAPHIC DATA. Doury, A.; Gerard, R. (CEN de Saclay, Gif-sur-Yvette, France). pp 473-483 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975). (In French)

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

The general problem of compatibility between given installations and their site, as well as more specific problems such as those associated with decisions to be taken in regard to demographic equilibrium in the environment, logically involve finding quantitative or at any rate semiquantitative criteria that will enable selection to be made under the least subjective conditions possible. Since the air is frequently the principal primary vector of effluents, especially in the case of an accident, atmospheric discharges are considered first separately. As the task is to find a "site security index" integrating the meteorological and demographic data with radiological data relating to the potential sources and the consequences of contamination, the authors first consider the possibility of using the man · rem concept, which has the advantage of possessing the dimension of a collective dose. In view of the objections that have been raised, particularly in connection with the controversy over the existence of a threshold for the dose-equivalent effect relation, a number of other practices are described and discussed. The conclusions are complex and subject to revision. Several definitions of site security indices can be identified and, pending the final decision stage, actually put into use, in conjunction with specific maps or graphs serving to reveal potentially important features which might be obscured by excessive integrations or summations. (auth)

25423 EXPERIMENTS ON DIFFUSION INTO THE ATMOSPHERE AND INTO THE SEA OF DISCHARGES FROM NUCLEAR INSTALLATIONS. Cagnetti, P. (CNEN-CSN Casaccia, Rome). pp 485-495 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975). (In French)

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

The Environmental Radioactivity Laboratory (Casaccia Nuclear Research Centre, Rome) and the Marine Radioactive Contamination Laboratory (Fiascherino, La Spezia) of the Italian National Energy Commission have developed various experimental methods for studying the diffusion of pollutants in the atmosphere and in sea-water. Micrometeorological techniques have been developed to study the thermodynamic behaviour of the lower layer of the atmosphere (0-500 m). Various methods have also been developed for determining the diffusion coefficients in the vertical and horizontal directions. In addition, theoretical and experimental studies have been performed with the aim of evaluating the mean concentrations in the atmosphere for continuous discharges. Numerous examples of the application of these techniques are cited in the text. The Fiascherino Laboratory has performed numerous experiments on the diffusion of liquid effluents in sea-water in the Gulf of Taranto (Southern Italy), off the Trisaia Nuclear Research Centre (National Nuclear Energy Commission). The outlay necessary to collect all the various data is justified by the intention to study the capacity of the Centre to accept large nuclear installations in the future. The data have been used to calculate the limiting radiological capacity for different lengths of discharge pipe and they will also provide a means of evaluating the impact on the environment of releases from other facilities which might be constructed on the same site in the future. (auth)

25424 AREAS AFFECTED BY GROUND DEPOSITION OF ^{137}Cs AND DESCRIPTION OF THE COMPUTER CODE ARCON. Tveten, U. (Institutt for Atomenergi, Kjeller, Norway). pp 497-515 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

The paper deals with the combined probability analysis and parametric study of ^{137}Cs deposition after a postulated nuclear reactor accident. The study is performed for a 3000 MW(th) reactor at a site typical of the Oslo Fjord area. No efforts have been made to determine definite accident sequences or amounts of release. It is simply postulated that an accident has taken place that will lead to release of a large amount of radioactivity to the atmosphere during a relatively short time period: on the order of one hour. The size of the area affected by a certain release of radioactive caesium depends upon the meteorological conditions during the release time period. Local weather data have been used to determine the probability of a certain magnitude of the area. The results are given in the form of conditional, cumulative probabilities. Conditional because they give the probability of a certain magnitude of the consequence if the release has taken place and the wind is blowing in the direction for which the weather data are valid. Cumulative because, e.g., the 5% probability means that the weather conditions may give these or worse consequences with a 5% probability or, expressed differently, they will give less severe consequences with a 95% probability. Since the calculations do not apply to a specific accident sequence, several pertinent release characteristics cannot be assigned a definite value. The most important are: amount of ^{137}Cs released; initial heat at release point; heat generated during plume transport due to decay of radioactive materials; and deposition velocity. The last item is only partially a release characteristic. Besides depending upon particle size and chemical conditions, the deposition velocity depends upon characteristics of the land area over which deposition takes place. A parametric study is performed by varying each of these characteristics over a certain range while keeping the others fixed at what it is reasonable to assume are typical values under extreme accident conditions. A computer code ARCON has been developed for this analysis, adaptable to a large range of calculations connected to atmospheric releases during accident conditions as well as normal operation, e.g., calculation of reference levels for milk consumption, health effects on specified populations, and the area within any kind of concentration limit or dose limit (except external γ dose). (auth)

25425 SEISMOLOGICAL STUDIES CARRIED OUT BY THE CEA IN CONNECTION WITH THE SAFETY OF NUCLEAR SITES. Barbreau, A.; Ferrieux, H.; Mohammadioun, B. (CEN de Saclay, Gif-sur-Yvette, France). pp 517-540 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975). (In French)

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

In order to evaluate the seismic risk at nuclear sites, the Department of Nuclear Safety of the French Atomic Energy Commission (CEA) has been conducting a programme of seismological studies for several years. This programme is aimed at acquiring a better knowledge of seismic phenomena, in particular the spectral distribution of the energy of earthquakes, considered to be the only correct approach to the problem of earthquake protection, as well as a better knowledge of the seismic activity of the areas surrounding nuclear sites. The authors propose defining the design spectrum of the site on the basis of the probable energy at the source, the distance from the epicentre and the transfer function of the geological formations. The need to acquire data on the characteristics of French earthquakes and on regional seismicity led the Department of Nuclear Safety to set up a network of seismic stations. It now has an observatory at the Cadarache Nuclear Research Centre and mobile stations with automatic magnetic recording for studying aftershock sequences and the activity of faults in the vicinity of nuclear sites, and for making the measurements necessary to calculate the transfer functions. With this equipment it was possible to record six aftershocks of the Oleron earthquake on 7 September 1972 close to the epicentre, and to calculate the spectra therefrom. The latter contained a lot of high frequencies, which is in agreement with the data obtained from other sources for earthquakes of low energy. The synthetic spectra calculated on the basis of one magnitude and one distance are in good agreement with the spectra obtained experimentally. (auth)

25426 CONNECTIONS BETWEEN SITING, NORMAL OPERATING PRACTICES, STRUCTURAL LAY-OUT AND QUALITY ASSURANCE: PRESENT SITUATION AND FUTURE OUTLOOK FOR NUCLEAR POWER PLANTS. Vinck, W.; Luykx, F.; Maurer, H.; Van Caeneghem, J. (Commission of the European Communities, Brussels). pp 541-561 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

The choice of reactor site must take into consideration the release of radioactive effluents during normal operation and the potential of accident situations. A description is given of how, in the European Community, the actual practice of effluent

control has succeeded in limiting exposure around nuclear power plant sites to extremely low values. Procedures to limit releases followed in the different countries are described and ideas are given on the approach which would be the most appropriate in the future, taking into account the increase in unit size and the tendency to create multi-unit sites. In the context of prevention of accident initiation, a discussion is presented of some of the efforts employed in the analysis of design and construction problems, quality control, in-service inspection and testing of the thick-walled primary components (pressure vessel). Emergency core cooling and containment systems are briefly discussed for their role in reducing the consequences of accident situations. (auth)

25427 NUCLEAR ENERGY IN A DENSELY POPULATED AND BUILT-UP COUNTRY SUCH AS THE FEDERAL REPUBLIC OF GERMANY. Bonnenberg, H.; Eschhaus, M.; Hensel, W.; Kayser, J. (Bonnenberg and Drescher Ingenieurgesellschaft mbH, Aldenhoven, Ger.). pp 563-580 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

Nuclear energy is absolutely necessary for the Federal Republic of Germany. By 1995, 75% of the energy used in that country for electricity production will be nuclear, which means an installed nuclear power of ~100,000 MW with all its nuclear infrastructure such as fuel fabrication, reprocessing, waste disposal and transport of a great deal of radioactive material between these services. Many sites are needed for these activities, including transport, which is, in fact, comprised of moving sites on special lines. Risk analysis is also needed for all this, the basis of which is the use of land in the western part of the country by population and industry. The Federal Republic of Germany is one of the most densely populated and built-up areas in the world. A computer program with a voluminous information system which stores all the relevant land-use data was written. A simulation program was also written to analyse the required regional capacity for transport of nuclear material in respect of different sites for power plants, reprocessing plants and waste disposal. This simulation program makes optimization with variable criteria. All the railway lines which can be used for heavy transport are stored in the computer as well as the traffic routes and rivers. The computer calculations show that, especially for selection of sites for reprocessing plants, the minimization of transport should be an important criterion in an intensely used country like the Federal Republic of Germany. The country will be forced to undertake detailed regional planning for the introduction of nuclear energy to achieve minimum risk to the population and minimum risk to the introduction itself. (auth)

25428 EVALUATION OF BLAST WAVE DAMAGE FROM VERY LARGE UNCONFINED VAPOUR CLOUD EXPLOSIONS. Munday, G. (Imperial Coll., London); Cave, L. pp 597-604 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

A mathematical model is described for estimating the damage potential from unconfined vapor cloud explosions. An attempt has been made to cover the salient details of the explosive phenomenon including finite flame accelerations and finite vapour cloud sizes. The model has been evaluated against two industrial incidents and the results extrapolated to large-volume vapour clouds. The authors conclude, on the evidence of this model, that great care must be taken in the evaluation of the explosion hazard from the probable occurrence of very large unconfined explosions even at distances in excess of 1 km from the centre of initiation. (auth)

25429 EXTERNAL HAZARDS AS THEY AFFECT NUCLEAR POWER PLANT SITING. Grimes, B. K. (Atomic Energy Commission, Washington, DC). pp 133-142 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

The USAEC Regulatory Staff (soon to be known as the Nuclear Regulatory Commission) has recently issued guidance to utilities in the areas of man-made hazards and natural phenomena which may influence availability and development costs of candidate nuclear power plants. They are in the form of regulatory guides and revisions to the standard format and content of safety-analysis reports. It has also issued guides to its own staff in the form of review plans, some of which have been recently completed and made available to the public. A summarization is presented of the USAEC guides now available on the subject of external hazards, and typical hazards are discussed which are given attention by the regulatory staff in the course of the review of an application to construct a nuclear power plant. (auth)

25430 EXPERIENCE IN ASSESSING ACCEPTABILITY OF NUCLEAR SITES SELECTED BY THE UTILITY INDUSTRY IN THE USA: 1971-1974. Gustafson, P. F. (Argonne National Lab., IL). pp 219-226 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

Considerable first-hand experience has been accumulated during the past decade in the USA on selection of suitable sites for nuclear facilities. Initially, sole consideration was given to safety aspects in site selection and approval. Since 1970, the National Environmental Policy Act has required that consideration also be given to potential adverse environmental impacts. Over 100 applications for construction permits had been or were being processed by the USAEC up to autumn 1974. Safety remains the foremost factor in site acceptability, followed by environmental considerations, and, although not a formal requirement, socio-economic issues are also considered in site evaluation. Nuclear safety guides and criteria are covered by existing regulations; hence, decisions on safety aspects of site selection are fairly straightforward. The prime safety issues are public health and safety under routine operating conditions and under all conceivable accident conditions. The constraint against siting nuclear facilities in or near heavily populated areas minimizes the problem of public safety. Siting in regions where the probability of natural events such as earthquakes, tidal waves or floods must be avoided. The methodology for site acceptance from an environmental standpoint is still in a developmental stage. The objective is now to reduce the probable environmental impact due to construction and operation of nuclear facilities. Reduction may be accomplished in a number of ways, the most extreme being the use of another site. Less severe changes may involve one or more of the following: primary cooling system, water intake and discharge design, radwaste and chemical waste systems, and transmission-line routing. Early site selection on a regional basis is also being considered. Such an approach will lead to a balance between the need for land and the environmental costs associated with nuclear power production and other land and environmental uses which also benefit mankind. (auth)

25431 RADIOACTIVE EFFLUENT RELEASES AND THE PUBLIC ACCEPTANCE OF NUCLEAR FACILITY SITES. Hull, A. P. (Brookhaven National Lab., Upton, NY). pp 247-263 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

A public controversy about the risks from radioactivity in effluents from nuclear power plants in the United States of America arose in the late 1960s, as their utilization was growing towards large-scale commercial basis. Several scientific critics alleged variously that the existing plants had occasioned excess infant mortality in their vicinities and that the growth of nuclear power would produce large increases in the cancer death rate in the general population. The controversy caused by these allegations led to the Biological Effects of Ionizing Radiation Committee's review of the effects of exposure to low levels of ionizing radiation. It also appeared to underlie the USAEC's "Appendix I" proposals for numerical design limits for nuclear power plant effluents. These proposals are intended to limit the dose of any nearby individual to 5 mR/a. A critical assessment is presented which indicates that the critics' allegations were either without substance or irrelevant. Using effluent release data from recent years, the population health risk from power-reactor effluent radiation exposures appears to be far smaller than that from fossil-fuelled plant effluents, as well as within the range of those otherwise considered as negligible. Such comparisons are suggested as more hopeful towards achieving public acceptance than "as low as practicable" measures, which serve to exaggerate the risks of radiation. (auth)

25432 QUANTIFIED SOCIAL AND AESTHETIC VALUES IN ENVIRONMENTAL DECISION MAKING. Burnham, J. B. (Battelle Pacific Northwest Labs., Richland, Wash.); Maynard, W. S.; Jones, G. R. pp 307-326 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

A method has been devised for quantifying the social criteria to be considered when selecting a nuclear design and/or site option. Community judgement of social values is measured directly and indirectly on eight siting factors. These same criteria are independently analyzed by experts using techno-economic methods. The combination of societal and technical indices yields a weighted score for each alternative. The aesthetic impact was selected as the first to be quantified. A visual quality index was developed to measure the change in the visual quality of a viewscape caused by

construction of a facility. Visual quality was measured by reducing it to its component parts—intactness, vividness and unity—and rating each part with and without the facility. Urban planners and landscape architects used the technique to analyze three viewscapes, testing three different methods on each viewscape. The three methods used the same aesthetic elements but varied in detail and depth. The technique with the greatest analytical detail was the most reliable method. Social value judgements were measured by social psychologists applying a questionnaire technique, using a number of design and site options to illustrate the range of criteria. Three groups of predictably different respondents—environmentalists, high-school students and businessmen—were selected. The three groups' response patterns were remarkably similar, though businessmen were consistently more biased towards nuclear power than were environmentalists. (auth)

25433 UNDERGROUND SITING OF NUCLEAR POWER REACTORS. Karpenko, V. N.; Walter, C. E. (Univ. of California, Livermore). pp 581-595 of Siting of Nuclear Facilities. Vienna; International Atomic Energy Agency (1975).

From symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974). See STI/PUB-384; CONF-741210-.

A preliminary study of reactor siting has evolved a new concept of undergrounding that calls for excavation of an open pit. The reactor containment structure can be built using conventional construction techniques. After construction, the reactor vessel is covered with backfill material of defined permeability and porosity. Calculations show that because of this controlled permeability, radioactive seepage is confined in the backfill should an accident rupture the containment structure. The required depth of burial for complete confinement of the radioactive release is on the order of 100 m. Even a few meters of selected backfill, however, provide a dramatic reduction in the consequences of a transient release of radioactivity due to filtration and adsorption. In addition, backfill makes the reactor invulnerable to tornadoes and falling objects. Solving the containment issue in this economic manner makes close-in, metropolitan reactor siting a distinct possibility. (auth)

25434 ANALYSIS OF REACTIVITY OF FINAL SAFETY ASSURANCE OF THE MOBILE EDUCATIONAL REACTOR. Tsai, J. (National Tsing-Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 12: No. 2, 82-89(Jun 1975).

The reactivity of the Mobile Educational Reactor (MER) under final scramming is investigated by using the two-group diffusion method. The probabilities of the neutrons streaming from the gap are calculated by the numerical method and then the general solutions of the diffusion equation are solved. Results indicate that the reactivity is equal to $-0.08680\Delta k/k$ when the width of the gap is 5 cm. It is concluded that, by means of separating the MER core into two parts with a gap width of 5 cm, the core will certainly be scrammed. (auth)

25435 MONITORING OF TRITIUM IN AIR AT A HEAVY WATER REACTOR BY SILICA GEL. Ho, N. H. (National Tsing-Hua Univ., Hsinchu, Taiwan); Weng, P. S.; Tsai, C. M. Nucl. Sci. J. (Taiwan); 12: No. 2, 76-81(Jun 1975).

A method for the back extraction of water from silica gel was developed to detect the tritium in air at a heavy water reactor site. Though the average tritium concentration can only be obtained after a long sampling time, the method described provides a means to monitor tritium on a routine basis with high sensitivity using a simple apparatus. The method is also independent of sampling flow rate. (auth)

Reactor Theory and Calculation

Refer also to abstracts 24122, 25087, and 25303.

25436 (IFA-FR-127-1975) ASPECTS OF THE NEUTRON NOISE ANALYSIS IN VIEW OF DETERMINING THE KINETIC PARAMETERS OF THE NUCLEAR REACTORS WITH THERMAL NEUTRONS AT IFA, BUCHAREST. I. Method of the Reduced Variance. Fratiloiu, G.; Cristea, G.; Ceaus, M.; Cercel, L. (Comitetul de Stat pentru Energia Nucleara, Bucharest (Romania)). Mar 1975. 31p. Dep. NTIS (US Sales Only) $4.75.

An introduction is made to the fundamental concepts specific of the study of the stochastic processes. The non-Poissonian character is emphasized of the probability distribution of the number of neutrons recorded by a chain of counters within a given time interval, i.e., of the number representing the physically observable that is holding informations concerning the fluctuations of the neutron populations in the reactor. The difficult problem of collecting the experimental data in view of determining the reduced variance of the physically observable is solved by means of electronic equipment which is sorting these experimental data in such a way that the relative recording frequencies of a given number of neutrons in Δt interval is directly determined. The fundamental diagram is described of the analysis chain after which a description is given of the fundamental diagram as well as of the signal diagram supplied by the stochastic multi-channel analyser achieved by printed circuits in the form of a NIM module. 11 references. (auth)

25437 METHOD OF EVALUATING THE PRECISION OF CROSS-SPECTRAL DENSITY MEASUREMENTS OF RANDOM NOISE. Cohn, C. E. (to U. S. Energy Research and Development Administration). US Patent 3,886,333. G21c17/00; G06g7/19. 27 May 1975. Filed Date 21 Dec 1973. 9p.

PAT-APPL-427,393.

This invention relates to a method of measuring parameters of a nuclear reactor by noise measurements. Noise signals are developed by the detectors placed in the reactor core. The polarity coincidence between the noise signals is used to develop quantities from which various parameters of the reactor can be calculated. (Official Gazette)

25438 NUCLEAR FUEL ELEMENT CONTAINING STRIPS OF AN ALLOYED Zr, Ti, AND Ni GETTER MATERIAL. Grossman, L. N.; Packard, D. R. (to General Electric Co.). US Patent 3,898,125. 5 Aug 1975. Filed date 8 Dec 1971. 8p.

A nuclear fuel element for use in the core of a nuclear reactor is disclosed. The nuclear fuel element has disposed therein an alloy having the essential components of nickel, titanium and zirconium, and the alloy reacts with water, water vapor and reactive gases at reactor ambient temperatures. The alloy is disposed in the plenum of the fuel element in the form of strips and preferably the strips are positioned inside a helical member in the plenum. The position of the alloy strips permits gases and liquids entering the plenum to contact and react with the alloy strips. (Official Gazette)

25439 GAMMA-RAY ENERGY RELEASE IN THE DECAY OF FISSION PRODUCTS. Sasamoto, N. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment); Nemoto, T. (Toyo Engineering Corporation, Kasumigaseki, Chiyoda-ku, Tokyo, Japan). Nucl. Eng. Des.; 32: No. 2, 252-276(1975).

Total disintegration rate, gamma-ray energy release rate and energy spectrum of the fission products of ^{235}U, ^{239}Pu, ^{241}Pu, and ^{233}U by thermal neutrons, and ^{235}U, ^{238}U, ^{239}Pu and ^{232}Th by fission spectrum neutrons have been re-evaluated as a function of reactor operating times from 10^2 to 10^8 sec after shutdown. Decay scheme data were taken mainly from the Table of Isotopes and fission yields from Meek and Rider's 1972 recommendations. The calculated data are tabulated in detail to facilitate interpolation. (auth)

Reactor Components and Accessories

Refer also to abstract 25438.

25440 (BNL-19768) ELASTIC AND INELASTIC METHODS OF PIPING SYSTEMS ANALYSIS: A PRELIMINARY REVIEW. Reich, M.; Esztergar, E. P.; Spence, J.; Boyle, J.; Chang, T. Y. (Brookhaven National Lab., Upton, N. Y. (USA)). Feb 1975. 71p. Dep. NTIS $6.75.

A preliminary review of the methods used for elastic and inelastic piping system analysis is presented. The following principle conclusions are reached: techniques for the analysis of complex piping systems operating in the high temperature creep regime should be further developed; accurate analysis of a complete pipework system in creep using the "complete shell finite element methods" is not feasible at the present, and the "reduced shell finite element method" still requires excessive computer time and also requires further investigation regarding the compatibility problems associated with the pipe bend element, particularly when applied to cases involving general loading conditions; and with the current size of proposed high temperature systems requiring the evaluation of long-term operating life (30 to 40 years), it is important to adopt a simplified analysis method. A design procedure for a simplified analysis method based on currently available techniques applied in a three-stage approach is outlined. The work required for implementation of these procedures together with desirable future developments are also briefly discussed. Other proposed simplified approximations also are reviewed in the text. 101 references. (auth)

25441 (ORNL-5044(Vol. 1)) STRESS ANALYSIS OF FLAT PLATES WITH ATTACHED NOZZLES. Vol. 1. Comparison of Stresses in a One-Nozzle-to-Flat-Plate Configuration and in

a Two-Nozzle Configuration with Theoretical Predictions. Bryson, J. W.; Callahan, J. P.; Gwaltney, R. C. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 124p. AT.

Strain-gaged steel models consisting of a single nozzle attached to a square, flat plate and two nozzles attached to a square, flat plate were tested, and the experimentally determined elastic stress distributions were compared with calculated values obtained using the computer code μVT-1, which was developed at Battelle-Columbus Laboratories and adapted for use at ORNL. Both models consisted of plates $36 \times 36 \times 0.375$ in. to which were attached nozzles having a thickness of 0.25 in., an outside diameter of 2.625 in., and a height of 8.5 in. Four types of loadings were applied to the single-nozzle configuration: (1) a 1:1 biaxial plate loading, (2) a 1:1/2 biaxial plate loading, (3) a nozzle axial thrust loading, and (4) a nozzle bending-moment loading. A total of nine loadings was applied to the two-nozzle configuration: three biaxial loads on the plate, and an axial thrust and two bending-moment loadings on each of the nozzles. The comparisons of experimental and calculated results show reasonably good agreement. The biaxial loadings on the plate, which simulate an internal pressure loading in a large-radius-of-curvature vessel, give the best overall agreement between experimental and analytical results. 7 references. (auth)

25442 IMPROVED CONSTRUCTION METHODS USED AT THE CONSTRUCTION SITE OF THE KOLSAKAYA NUCLEAR POWER PLANT. Kostin, A. Ekspress-Inf., Svar. Rab.; No. 1, 4-6(1973). (In Russian).

Changes were made in the installation of the circular vessel which made it possible to use automatic welding of seams of the main circulation piping and to improve the assembly. Welding of the fins of the trap water container with interrupted seams prevented warping and decreased the cost. The lamina of the floor linings in the housing were automatically welded. (tr-auth)

25443 PRESSURE VESSELS AND PIPING: VERIFICATION AND AND QUALIFICATION OF INELASTIC ANALYSIS COMPUTER PROGRAMS. Corum, J. M.; Wright, W. B. (eds.). New York; American Society of Mechanical Engineers (1975). 116p. (CONF-750617-16).

Seven papers are presented which describe stainless steel-304 structural behavior studies and the resulting benchmark problem data for thirteen separate structural tests on seven different geometries. The mechanical and physical material properties normally needed as input for benchmark calculations are included in an appendix. The seven papers and the appendix were separately abstracted and indexed for NSA. (DG)

For abstracts of individual papers see: 25286 and 25444–25450.

25444 ROOM TEMPERATURE ELASTIC-PLASTIC RESPONSE OF THIN-WALLED TUBES SUBJECTED TO NONRADIAL COMBINATIONS OF AXIAL AND TORSIONAL LOADINGS. Liu, K. C. (Oak Ridge National Lab., TN). pp 1-12 of Pressure Vessels and Piping: Verification and Qualification of Inelastic Analysis Computer Programs. Corum, J. M.; Wright, W. B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-16.

Two tubular specimens of Type 304 stainless steel with uniform thin walls were subjected to a program of segmental combined tension/compression and torsion loadings at room temperature. A proportional, or radial, loading into the plastic range was initially applied to each specimen. Two nonproportional (nonradial) loadings along straight-line segments for which neither the loading paths nor their linear extrapolations passed through the origin of the stress space were then applied. The axial and torsional stress-strain curves for these segmental prestress loadings are presented. Hence, the stress-strain response characteristics for nonproportional loading as well as for proportional loading can be studied. In addition, the axial and torsional plastic strain components were calculated, and the total plastic strain trajectories are plotted in a plastic strain space. Finally, using results from a detailed study of yield surfaces, which was performed for the first specimen, a spectrum of initial and subsequent yield curves corresponding to the segmental prestress loadings is presented. (auth)

25445 ELEVATED-TEMPERATURE TESTS OF SIMPLY-SUPPORTED BEAMS AND CIRCULAR PLATES SUBJECTED TO TIME-VARYING LOADINGS. Corum, J. M.; Richardson, M. (Oak Ridge National Lab., TN). pp 13-25 of Pressure Vessels and Piping: Verification and Qualification of Inelastic Analysis Computer Programs. Corum, J. M.; Wright, W. B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-16.

The measured elastic-plastic and elastic-plastic-creep responses of a number of simply-supported Type 304 stainless steel beams and circular plates are presented. Beams and plates exhibit the essential features of inelastic structural behavior; yet they are relatively simple. In beams, the stress fields are largely uniaxial, while multiaxial effects are introduced in plates. The specimens were laterally loaded at the center, and the tests were performed by subjecting the specimens to either a prescribed load or center-deflection history. The specimens were machined from a common, well-characterized heat of material, and all of the tests were performed at a temperature of 1100°F. The elastic-plastic tests consisted of short-time cycling of the center load, or deflection, between fixed limits. In the elastic-plastic-creep tests the center load, or deflection, was held constant for periods of time, but was periodically subjected to a step increase or decrease, including reversals. The test results are presented in terms of the load and center-deflection behaviors, which typify the overall structural behavior. (auth)

25446 RESIDUAL STRAINS IN A STAINLESS STEEL PLATE WITH A CIRCULAR HOLE AND SUBJECTED TO REVERSE LOADING AT ELEVATED TEMPERATURE. Durelli, A. J.; Buitrago, J. (Catholic Univ. of America, Washington, DC). pp 27-37 of Pressure Vessels and Piping: Verification and Qualification of Inelastic Analysis Computer Programs. Corum, J. M.; Wright, W. B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-16.

A description is given of studies directed at the determination of strains in a stainless steel plate with a circular hole and subjected to a temperature of 1100°F and to a successively applied tensile and compressive in-plane loading sufficiently large to produce plastic strains and creep. The duration of this test was 1000 hours. Square grids of lines (at a distance of 0.25 in.) and crossed-gratings (500 lines/in.) were engraved on both surfaces of the plate before the test. After the plate was unloaded and brought back to room temperature the grids were analyzed using traveling microscopes, and the gratings using the moire effect. Both Cartesian strains were determined from the moire isothetics along the axes of the plate, along the two lines tangent to the hole and parallel to those axes, and along the edges of the plate. Grid measurements were also made at specific points, and the deformed shapes of the hole and of the plate were determined. It is estimated that strains larger than 0.001 can be determined with the techniques and methods used. (auth)

25447 ELEVATED-TEMPERATURE-ELASTIC-PLASTIC-CREEP TEST OF A SHEAR-LAG PANEL. Egger, R. L. (Boeing Aerospace Co., Seattle). pp 29-45 of Pressure Vessels and Piping: Verification and Qualification of Inelastic Analysis Computer Programs. Corum, J. M.; Wright, W. B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-16.

A description is given of a test program to provide elastic-plastic-creep structural test data for comparison with inelastic analysis predictions, and to demonstrate the capabilities of high-temperature capacitive strain gages as long-term stable strain-measuring devices. The test specimen used was a shear-lag structure consisting of a thin, square, stainless-steel plate loaded in its plane through tapered stiffeners. A shear-lag specimen was instrumented with ten capacitive strain gages, heated to 1100°F and subjected to long-term tensile and compressive loads. Capacitive strain gage data from the long-term test are presented and discussed. (auth)

25448 TESTS AT ROOM TEMPERATURE AND 1100 F ON A 4-IN. SCH. 10 ELBOW-PIPE ASSEMBLY SUBJECTED TO IN-PLANE MOMENT LOADING. Griffith, W. I.; Rodabaugh, E. C. (Battelle's Columbus Labs., OH). pp 59-78 of Pressure Vessels and Piping: Verification and Qualification of Inelastic Analysis Computer Programs. Corum, J. M.; Wright, W. B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-16.

A 4-in. Sch. 10 Type 304 stainless steel elbow was welded to pipe legs and subjected to an in-plane moment loading at room temperature and at 1100°F. Loads were applied by weights. Displacements and strains were measured. The results are presented and discussed in relationship to relatively simple theories for elastic and plastic/creep behavior of elbows. (auth)

25449 COMPARISON OF TYPICAL INELASTIC ANALYSIS PREDICTIONS WITH BENCHMARK PROBLEM EXPERIMENTAL RESULTS. Clinard, J. A.; Corum, J. M.; Sartory, W. K. (Oak Ridge National Lab., TN). pp 79-98 of Pressure Vessels and Piping: Verification and Qualification of Inelastic Analysis Computer Programs. Corum, J. M.; Wright, W. B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-16.

The results of exemplary inelastic analyses are presented for a series of experimental benchmark problems. Consistent analytical procedures and constitutive relations were used in each of the analyses, and published material behavior data were used in all cases. Two finite-element inelastic computer programs were employed. These programs implement the analysis procedures and constitutive equations for Type 304 stainless steel that are currently used in many analyses of elevated-temperature nuclear reactor system components. The analysis procedures and constitutive relations are briefly discussed, and representative analytical results are presented and compared to the test data. The results that are presented demonstrate the feasibility of performing inelastic analyses, and they are indicative of the general level of agreement that the analyst might expect when using conventional inelastic analysis procedures. (auth)

25450 APPENDIX, MATERIAL PROPERTY DATA FOR ELASTIC-PLASTIC-CREEP ANALYSES OF BENCHMARK PROBLEMS. Corum, J. M. (Oak Ridge National Lab., TN). pp 99-109 of Pressure Vessels and Piping: Verification and Qualification of Inelastic Analysis Computer Programs. Corum, J. M.; Wright, W. B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-16.

A summary of applicable stainless steel-304 material property data is presented which is required as input to conventional elastic-plastic and elastic-plastic-creep analyses. The data include elastic constants and a monotonic stress-strain curve at room temperature, elastic constants, cyclic stress-strain curve, physical properties for the 800 to 1100°F temperature range, and uniaxial, constant-stress creep data for a temperature of 1100°F. (auth)

25451 RELIABILITY ENGINEERING IN PRESSURE VESSELS AND PIPING. Gangadharan, A. C. (ed.). New York; American Society of Mechanical Engineers (1975). 108p. (CONF-750617-18).

A compilation is presented of six papers dealing with various aspects of reliability analysis and applications in nuclear power plant pressure vessels and piping designs. Each paper has been separately abstracted and indexed for NSA. (DG)

For abstracts of individual papers see: 25246-25248, 25288, 25452, and 25453.

25452 IMPACT OF INSERVICE INSPECTION ON THE RELIABILITY OF PRESSURE VESSELS AND PIPING. Bush, S. H. (Battelle-Northwest, Richland, WA). pp 1-13 of Reliability Engineering in Pressure Vessels and Piping. Gangadharan, A. C. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-18.

The reliability of pressure components of a nuclear reactor is a function of the as-fabricated quality plus a program of continuing inspection during operation. Since insufficient data exist to quantitatively determine failure probabilities of nuclear pressure vessels and piping, it is necessary to utilize information from comparable non-nuclear systems such as power boilers. Based on probabilistic studies it is inferred that in-service inspection improves component reliability one-to-two orders of magnitude depending on the type and completeness of the inspections. An attempt is made to assess the significance of the ASME Section XI Code as to relative completeness of inspection and the probable improvement in reliability. (auth)

25453 RELIABILITY OF DEFECT DETECTION IN WELDED STRUCTURES. Packman, P. F.; Malpani, J. K.; Wells, F.; Yee, B. W. E. (Vanderbilt Univ., Nashville). pp 15-28 of Reliability Engineering in Pressure Vessels and Piping. Gangadharan, A. C. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-18.

An analysis has been made of the ability of several nondestructive inspection procedures to reliably detect surface fatigue cracks. It is shown that the ability of penetrant systems of aluminum and titanium are over 90 percent for cracks whose surface length is greater than 0.939 mm (0.037 inches) in length and decreases for cracks less than this value. The probability of detection of these cracks, given that the crack is present has been determined at 90, 95, and 99 percent confidence factors. The conditional probabilities associated with an error call have also been developed. (auth)

25454 THERMAL POWER PLANTS. Beckmann, G.; Gilli, P. V. (to Waagner-Biro Aktiengesellschaft). US Patent 3,890,789. 24 Jun 1975. Priority date 7 Dec 1972, Austria. 8p.

A thermal power plant such as a nuclear power plant is described where a primary circuit is provided for generating primary power while an accumulator circuit communicates with the primary circuit for generating additional power to be utilized for peak loads. The accumulator circuit includes displacement accumulators communicating with steam-generating units for providing the energy to be utilized for the additional peak power. Fluid is circulated between the displacement accumulators and steam generator units by way of a circulating conduit system and a fluid-circulating structure communicating therewith. This fluid-circulating structure is driven from a drive accumulator, so that it is not necessary to use electricity in order to circulate the fluid of the accumulator circuit. (Official Gazette)

25455 METHOD AND SYSTEM OF SIMULATING NUCLEAR POWER PLANT COUNT RATE FOR TRAINING PURPOSES. Alliston, W. H.; Koenig, R. H. (to Westinghouse Electric Corp.). US Patent 3,896,041. 22 Jul 1975. Filed date 14 Mar 1973. 16p.

A method and system are described for the real-time simulation of the dynamic operation of a nuclear power plant in which nuclear flux rate counters are provided for monitoring the rate of nuclear fission of the reactor. The system utilizes apparatus that includes digital computer means for calculating data relating to the rate of nuclear fission of a simulated reactor model, which rate is controlled in accordance with the operation of control panel devices. A digital number from the computer corresponding to the flux rate controls an oscillator driven counter means to produce a pulse after a predetermined count. This pulse controls an oscillator driven polynomial counter to count a random number that controls a third counter in accordance with pulse from the first counter to produce a random fission count for operating the meters. (Official Gazette)

25456 COMMUNICATION BETWEEN REDUNDANT PROTECTION AND SAFEGUARDS LOGIC SYSTEMS WITHIN NUCLEAR REACTOR POWER PLANTS BY MEANS OF LIGHT. Neuner, J. A. (to Westinghouse Electric Corp.). US Patent 3,888,772. 10 Jun 1975. Filed date 4 Apr 1972. 8p.

An improved nuclear reactor protection and safeguard system is disclosed having a plurality of sensors for monitoring reactor and environmental parameters associated with reactor operation. The sensor outputs are communicated along two substantially similar isolated trains of logic to a logic function which interprets the monitored signals. Upon the occurrence of a predetermined combination of the monitored signals the protection and safeguards system actuates corresponding safeguards and protection mechanisms associated with the reactor to control and protect against the occurrence of an adverse reactor operating condition. The improvement provided maintains both physical and electrical insulation between the two trains of logic while enabling communication between the trains of the information contained therein where necessary by means of light. (Official Gazette)

25457 APPARATUS FOR FILTERING RADIOACTIVE FLUIDS. Gischel, E. H. US Patent 3,890,233. 17 Jun 1975. Filed date 25 Apr 1974. 14p.

Apparatus is provided for filtering radioactive particles from the cooling and/or auxiliary process water of a nuclear reactor, or nuclear fuel processing plant, or other installations wherein radioactive fluid systems are known to exist. The apparatus affords disposal of the captured particles in a manner which minimizes the exposure of operating personnel to radioactivity. The apparatus comprises a housing adapted to contain a removable filter cartridge assembly, a valve normally closing the lower end of the housing, an upwardly-open shipping cask located below the valve, and an elongated operating rod assembly projecting upwardly from the filter cartridge assembly and through the upper end of the housing to enable a workman to dismount the filter cartridge assembly from its housing and to lower the filter cartrfdge assembly through the valve and into the cask from a remote location above the housing. (Official Gazette)

25458 NUCLEAR REACTOR REFUELLING MACHINE. Peberdy, J. M. (to United Kingdom Atomic Energy Authority). US Patent 3,897,878. Priority date 2 Oct 1972, United Kingdom of Great Britain and Northern Ireland. 8p.

A guide tube for a fuel element assembly gripper unit is radially displaceable on a parallel linkage from the lower end of a vertically disposed rotatable support structure. The gripper unit is longitudinally slidable within the guide tube to enable a fuel element assembly to be fully withdrawn into the guide tube. The gripper unit has a rotatable gripper head for rotating the fuel element assembly about its longitudinal axis. (Official Gazette)

25459 METHOD OF CLEANING NUCLEAR POWER PLANTS. Korn, R.; Seyd, G.; Paulsen, U. (to Siemens Aktiengesellschaft). US Patent 3,894,364. 15 Jul 1975. Priority date 4 Dec 1972, F. R. Germany. 6p.

The method described cleans components of nuclear reactor power plants, as for example steam generators, by blasting the contaminated surface with boron trioxide sand propelled by compressed gas, withdrawing the gas containing suspended boron trioxide particles and abraded solid particles from the atmosphere around the treating area and passing the gas containing suspended particles through a vortex separator to separate the particles from the gas. The gas after removal of the particles may be returned to the chamber enclosing the surfaces to be cleaned thereby minimizing contamination in the area surrounding the enclosed chamber. (Official Gazette)

25460 REACTOR PRESSURE TANK. Dorner, H.; Scholz, M.; Jungmann, A. (to Siemens Aktiengesellschaft). US Patent 3,898,126. 5 Aug 1975. Priority date 23 Dec 1971, F. R. Germany. 8p.

In a reactor pressure tank for a nuclear reactor, self-locking hooks engage a steel ring disposed over the removable cover of the steel vessel. The hooks exert force upon the cover to maintain the cover in a closed position during operation of the reactor pressure tank. The force upon the removal cover is partly the result of the increasing temperature and thermal expansion of the steel vessel during operation. The steel vessel is surrounded by a reinforced-concrete tank. (Official Gazette)

25461 CLEANING CONTAMINATED SURFACES OF NUCLEAR POWER PLANTS AND RECOVERY OF REMOVED SURFACE PARTICLES. Korn, R.; Seyd, G.; Paulsen, U. (to Siemens Aktiengesellschaft). US Patent 3,895,465. 22 Jul 1975. Priority date 4 Dec 1972, F. R. Germany. 6p.

Radioactively contaminated surfaces are cleaned by blasting the surface with particles of boron trioxide propelled through a jet with compressed gas. As a result of the abrading action, the boron trioxide becomes contaminated with abraded, radioactive solid particles. The abraded solid particles are separated from the boron trioxide by admixing water to dissolve the boron trioxide and then filtering the boron trioxide aqueous solution containing abraded solid particles to separate and recover the abraded solid particles in the boron trioxide solution. The boron trioxide aqueous solution may be treated to recover boron trioxide particles. The separated radioactive particles may be sent to a treating plant for concentration and recovery of radioactive values. (Official Gazette)

Reactor Fuels

Refer also to abstracts 24215–24217.

25462 (LA-6011-MS) ANALYSIS OF FUEL-BUNDLE RADIOGRAPHS USING MODELING. Demuth, H. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1975. Contract W-7405-ENG-36. 26p. Dep. NTIS $4.00.

It was desired to estimate the thickness of gaps imaged on highly degraded radiographs. A powerful mathematical method for estimating gap widths was developed and applied. The problem, the techniques used to solve the problem, and results, conclusions, and suggestions for future work are presented. (auth)

25463 SUSPENSION SCHEME FOR FUEL PIN. Butts, C. E.; Gray, H. C. (to U. S. Energy Research and Development Administration). US Patent 3,890,197. G21c3/32. 17 Jun 1975. Filed date 29 May 1961. 8p.

PAT-APPL-113,566.

A description is presented of a nuclear fuel pin suspension arrangement comprising, in combination, a rod; a first beam member connected to said rod at one end; a plurality of parallel-spaced slidable fuel support plates attached to said first beam member, the longitudinal axis of first beam member being perpendicular to the longitudinal axis of each of said fuel support plates, a first coupling means disposed along the length of the first beam member for permitting slidable fuel support plates parallel movement with respect to the longitudinal axis of said first beam member, a second coupling means located at one end of each of slidable fuel plates for slidably engaging first coupling means of first beam member, a second beam member connected to the other end of each of parallel-spaced slidable fuel support plates and providing an extension, second beam member being provided with a third coupling means disposed along the length of second beam member at one end thereof; and a plurality of fuel pins provided with a fourth coupling means located at one end of each fuel pin for slidably engaging third coupling means of second beam member to permit each fuel pin parallel movement with respect to the longitudinal axis of second beam member. (Official Gazette)

25464 FUEL ELEMENT ANALYSIS. Rashid, Y. R.; Weiler, F. C. (eds.). New York; American Society of Mechanical Engineers (1975). 65p. (CONF-750617-17).

Five papers are presented which deal with analytical and computational models for reactor fuel elements. Each paper has been separately abstracted and indexed for NSA. (DG)

For abstracts of individual papers see: 25245, 25261, 25287, 25306, and 25465.

25465 SAFE-COLAPS: A FINITE ELEMENT PROGRAM FOR THE CREEP COLLAPSE ANALYSIS OF NUCLEAR FUEL RODS. Tong, H. T.; Rashid, Y. R. (General Electric Co., San Jose, CA). pp 1-11 of Fuel Element Analysis. Rashid, Y. R. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2nd ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975). See CONF-750617-17.

A two-dimensional non-linear finite element program which treats the elastic, plastic and creep effects within the finite deformation theory and Lagrangian formulation is described. The capability of this program for the creep collapse analysis of nuclear fuel rods treated as empty thick tubes is demonstrated. This consists of three major areas: predictions of the exact elastic and elastic-plastic buckling loads of cylindrical shells, correlation of the collapse time with simplified closed form solutions and correlation with other numerical methods. The general capabilities of the program are also discussed. (auth)

25466 INLET FOR FUEL ASSEMBLY HAVING FINGER CONTROL RODS. Berglund, A.; Suvanto, A.; Tornblom, L. (to Allmanna Svenska Elektriska Aktiebolaget). US Patent 3,888,732. 10 Jun 1975. Filed date 14 Sep 1973. 4p.

A nuclear reactor with vertically arranged fuel assemblies positioned on supporting members and with control rods displaceably arranged in guide tubes between the fuel rods inside the fuel assemblies is described. The supporting plate is provided with a transverse end piece with throttling means for the liquid flow which passes from below up through the supporting member and past the fuel rods in the fuel assembly. The inlets for the guide tubes for the control rods are located below the end piece and the throttling means. In this way a higher pressure prevails at the inlet to the guide tubes than above the end piece, so that a stronger flow of coolant is produced through guide tubes than through the fuel assembly. (Official Gazette)

25467 NUCLEAR REACTOR FUEL ELEMENT ASSEMBLY SPACER GRID AND METHOD OF MAKING. Chetter, J. (to United Kingdom Atomic Energy Authority). US Patent 3,890,196. 17 Jun 1975. Priority date 7 Jul 1971, United Kingdom of Great Britain and Northern Ireland. 4p.

A cellular fuel element assembly spacer grid is described which provides for resilient bracing of fuel pins in the cells of the grid by bow spring locating members projecting inside the cells of the grid to hold the fuel pins against opposed rigid stops also projecting inside the cells of the grid. The grid comprises two tiers each formed from intersecting strip members defining cells which are penetrated by the fuel pins and arranged parallel to one another but spaced apart. The bow spring locating members extend longitudinally between the two tiers and have end ferrules which are a sliding fit on locating members which extend longitudinally from the facing inner edges of the strip members forming the two tiers. The grid tiers are fabricated individually by heat bonding the intersecting strip members prior to assembling the tiers into the spacer grid. (Official Gazette)

25468 INDUSTRIAL TECHNIQUE. Jabsen, F. S. (to Babcock and Wilcox Co.). US Patent 3,894,327. 15 Jul 1975. Filed date 23 Oct 1973. 14p.

An illustrative embodiment of the invention discloses a technique for disassembling a nuclear reactor fuel element without destroying the individual fuel pins and other structural components from which the element is assembled. A traveling bridge and trolley that span a water-filled spent fuel storage pool support a strongback. The strongback is under water and provides a working surface on which the spent fuel element is placed for inspection and for the manipulation that is associated with

disassembly and assembly. To remove, in a non-destructive manner, the grids that hold the fuel pins in the proper relative positions within the element, bars are inserted through apertures in the grids with the aid of special tools. These bars are rotated to flex the adjacent grid walls and, in this way relax the physical engagement between protruding portions of the grid walls and the associated fuel pins. With the grid structure so flexed to relax the physical grip on the individual fuel pins, these pins can be withdrawn for inspection or replacement as necessary without imposing a need to destroy fuel element components. (Official Gazette)

25469 NUCLEAR FUEL BUNDLE DISASSEMBLY AND ASSEMBLY TOOL. Yates, J.; Long, J. W. (to Exxon Nuclear Co., Inc.). US Patent 3,887,980. 10 Jun 1975. Filed date 29 Mar 1973. 6p.

A nuclear power reactor fuel bundle is described which has a plurality of tubular fuel rods disposed in parallel array between two transverse tie plates. It is secured against disassembly by one or more locking forks which engage slots in tie rods which position the transverse plates. Springs mounted on the fuel and tie rods are compressed when the bundle is assembled thereby maintaining a continual pressure against the locking forks. Force applied in opposition to the springs permits withdrawal of the locking forks so that one tie plate may be removed, giving access to the fuel rods. An assembly and disassembly tool facilitates removal of the locking forks when the bundle is to be disassembled and the placing of the forks during assembly of the bundle. (Official Gazette)

25470 ANALYTICAL SOLUTION TO A TWO-DIMENSIONAL MODEL OF THE REWETTING OF A HOT DRY ROD. Blair, J. M. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Eng. Des.; 32: No. 2, 159-170(1975).

The model considers a hot dry rod of infinite length cooled by a film of liquid moving along its surface. The heat transfer coefficient is assumed to be constant on the wet side and zero on the dry side of the rewetting front, and the liquid film is assumed to move at constant speed. An analytical formula relating the temperature difference in the rod, the temperature at the rewetting front, the wet side heat transfer coefficient, and the rewetting speed is derived. The formula applies to the rewetting of a fuel rod during emergency cooling by flooding. (auth)

25471 LATERAL TURBULENT DIFFUSION FOR LONGITUDINAL FLOW IN A RECTANGULAR CHANNEL. Nijsing, R.; Eifler, W.; Delfau, B. (SEE CODE- 1910825 Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Nucl. Eng. Des.; 32: No. 2, 221-238(1975).

The turbulent diffusivity for mass transfer in the wide direction of a 0.008 × 0.1 m rectangular duct was determined by continuous tracer injection. A hybrid computation method was used to analyze the axial development of time average lateral concentration distributions. For the investigated Reynolds number range, 30,000-86,000, the turbulent diffusivity of mass can be correlated by $\epsilon = 0.178 y_0 (\tau_w/\rho)^{1/2}$. From the diffusivity results one may infer the magnitude of the Lagrangian integral spatial scale of turbulence. (auth)

Reactor Control Systems

25472 (BNWL-B-218) MAGNETIC DISCONNECT FOR SECONDARY SHUTDOWN. Lessor, D. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 6 Mar 1972. Contract AT(45-1)-1830. 22p. Dep. NTIS $4.25.

A description is given of studies to develop a magnetic holding clutch in the control rod drive line as an alternate shutdown device for the FFTF. Results indicate that a three-phase disconnect, hold, and backup shutdown system can be designed to operate satisfactorily. (DG)

25473 (TID/SNA-3023) DYNAMIC REQUIREMENTS FOR BLOCK I ENGINE CONTROL SYSTEM. Kornfeld, E. L.; Mageean, J. V. (Aerojet-General Corp., Sacramento, Calif. (USA)). 25 Sep 1963. 21p. Dep. NTIS $4.25.

Declassified 10 Sep 1973.

The engine control system consists of three main control loops, the flux level control loop, the core exit gas temperature control loop and the chamber pressure control loop. These control loops, when combined with the engine programmer and the cooldown system, provide the complete engine control system. The basic control system components and their relationships at design point operation are shown. The reactor control subsystem is provided by WANL and consists of the flux level control loop, the temperature control amplifier and various logic circuits to accomplish nuclear startup and provide integration with the engine programmer. The drum control actuators and the turbine power control actuator are complete control loops within themselves and subloops of the flux control loop and the chamber pressure control loop, respectively. These actuators are being developed as complete systems in that the drive amplifier, feedback and compensation are being developed by the actuator subcontractors. The control system design is tailored to enable the engine and vehicle systems to meet the performance requirements. The purpose of the engine programmer is to provide the demanded inputs to the engine controls at the desired time so that the overall engine mission may be achieved. The function of the engine controls system is to carry out the programmer commands in a manner that provides a smooth transition from one operating point to another in the desired time period. All of the engine performance requirements are governed by mission requirements, safety limits, and engine component limitations. The engine limitations specify the maximum and minimum temperatures and pressures, the maximum rates of change of temperatures and pressure and other specific component limitations. Safety limits specify the reactor control drum rates and reactor periods and are governed by the ability of the control system to detect and control these parameters. (auth)

25474 (WANL-TME-525) NRX-A2 CONTROL SYSTEM PERFORMANCE DURING REACTOR STARTUP. Hafer, J. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Sep 1963. 29p. Dep. NTIS $4.50.

Declassified 14 Jul 1975.

The existing reactor power and temperature control systems in Test Cell A (KIWI-B4A controllers) have been analyzed to determine their suitability for control of the NRX-A2 series of reactor tests. The KIWI-B4A controllers were chosen because they have successfully controlled a reactor similar to the NRX-A2 design and the control hardware is presently integrated into the Test Cell A complex. The KIWI-B4A controller compensations and gains exhibit adequate stability as demonstrated by frequency response, step response and programmed startup in the subpower and power range. It is recommended, therefore, that the KIWI-B4A power and temperature control systems as described be used during the NRX-A2 series of tests. (auth)

25475 (WANL-TME-1361) CLUSTERED NERVA II ENGINE SYSTEM STUDIES. Kim, C. K. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1966. 76p. Dep. NTIS $7.00.

Declassified 16 Jul 1975.

Clustering of engines often introduces problems not present in a single engine, and clustering of nuclear engines presents some unique problems; i.e., (a) shielding of propellant tanks and engine components exterior to reactors, (b) power and flux tilting of reactor cores due to the reactivity coupling of cores, and (c) neutronic coupling of cores and control. Clustering of three unshielded engines and propellant tanks in a triangular array at 33 feet separation approximately doubles the heating rate in each propellant tank relative to the single tank and engine. Approximately 2900 lbs top shadow shield provides a reasonable and economic use of shield mass. The reactivity coupling between NERVA II reactors at 33 feet separation was estimated to be about 0.25¢ and the induced power level in a shutdown reactor resulting from an adjacent full-power reactor to be about 3MW at $4 shutdown. The core power tilting is less than one per cent for the estimated core coupling of 0.25¢ and will have negligible effects on thermal and mechanical performance of reactors. Clustered engines can be started up by following either programmed power demand or programmed drum position demand (automatic startup). Most control systems satisfactory for a single reactor control could be used for the control of clustered reactors. Neutron detectors do not require an additional shield to decouple. The gamma radiation environment for the NERVA II reactor is expected to be nearly two decades higher than the NRX-A reactor at the pressure vessel near the core mid-plane, and detectors may require a gamma shield. (auth)

25476 (WANL-TME-1542) PRELIMINARY REACTOR SYSTEM ANALYSIS FOR NERVA. Bell, R. S.; Lynch, R. M.; Blake, P. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1967. 25p. Dep. NTIS $4.25.

Declassified 10 Sep 1973.

Preliminary studies indicated that 5,000 megawatt NERVA has some dynamic characteristics which are different from those of the present 1100 MW system. These differences are tied-in quite strongly with the support system changes in the reactor design. Control of support system flow appears to provide a useful reactivity control which can be used with, and possible instead of, the control drum system. Control systems similar to those used on

the 1100 MW NERVA appear applicable to the 5000 MW size, i.e., use of control drums appears to be feasible for dynamic control of the 5000 MW NERVA over a wide range of conditions. (The low range of startup has not been studied). The NERVA model predicts an open loop "drift instability" for certain operating conditions. This draft characteristic apparently will not influence design of controllers relative to their small signal stability, but could influence their design relative to fail safe modes and required overrides. The "drift instability" is an open loop system problem arising from the interaction of the reactor with the rest of the engine, and does not affect closed loop performance. The studies in support of flight safety analysis indicated that with some revision, the NERVA Common Systems Model could be used in a TAF digital implementation form to provide reasonable predictions of flow transients resulting from rapid (0.2 second) turbopump speed ramps. (auth)

25477 METHOD AND APPARATUS FOR CONTINUOUS MONITORING AND CONTROL OF NEUTRON ABSORPTION PROPERTIES OF CHEMICAL SHIM WITH TEMPERATURE COMPENSATION. Schukei, G. E.; Kowles, J. E. (to Combustion Engineering, Inc.). US Patent 3,898,467. 5 Aug 1975. Filed date 18 Mar 1974. 10p.

An apparatus is described to continuously monitor and control the neutron absorption properties of chemical shim used in regulating reactivity of a pressurized water nuclear reactor. Coolant-moderator fluid, containing soluble chemical shim with a neutron absorption property is continuously passed through a chamber having at least one neutron detector spaced from a neutron source of known strength. Utilizing the neutron absorptiometery principle, a signal relating to the concentration of the chemical shim in the coolant-moderator is derived. In addition, the temperature of the sample of coolant is obtained and a temperature compensation signal is generated. The signal related to chemical shim concentration is modified by the temperature compensation signal to correct for temperature related effects. The corrected signal is then applied to a readout and alarm device so that constant monitoring of the shim concentration may be accomplished; additionally, the signal may be applied to maintain the concentration of the chemical shim in the coolant-moderator at a desired level. (Official Gazette)

25478 POSSIBILITY OF SIMULTANEOUS LOGARITHMIC-LINEAR DIRECT CURRENT MEASUREMENT. Sobajic, M. V. (Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia)). Nucl. Instrum. Methods; 125: No. 3, 401-412(15 Apr 1975).

A description is given of a simple circuit for direct current measurements in a wide range of several decades with simultaneously logarithmic and linear indications. The circuit is suitable for applications in systems for simultaneous measurements of the period and power of a nuclear reactor by using only one ionization chamber. Separate mathematical analyses are carried out for the cases of employing diodes and transistors as nonlinear elements. The obtained relations indicate the requirements imposed upon nonlinear elements and operational amplifiers to achieve a desired accuracy of measurements. Experimental results have shown that diodes permit covering of a measuring range of five linear decades whereas the transistors cover a measuring range of seven linear decades. The linearity was better than 0.15% per decade of variation of measured current. Temperature stability was better than 250 ppM/°C. (auth)

Nuclear Power Plant Economics

25479 (BNL-20273) ECONOMICS OF THE PRODUCTION OF LIQUID FUEL AND FERTILIZER BY THE FIXATION OF ATMOSPHERIC CARBON AND NITROGEN USING NUCLEAR POWER. Baron, S.; Steinberg, M. (Brookhaven National Lab., Upton, N. Y. (USA)). Jan 1975. 21p. (CONF-750812-12). Dep. NTIS $4.25.

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).

The increasing cost and the limited reserves of natural gas and oil in the U. S. are shifting the economics in favor of nuclear energy as a means of carbon and nitrogen fixation. Methanol blended with gasoline up to 30 percent by volume increases the performance of cars and reduces the emission of carbon monoxide without the need of catalytic converters. Longer term development of engines operating on 100 percent methanol will permit total elimination of pollutants from auto exhausts. Most important, the capital investment for methanol synthesis is less than oil and gas exploration and eliminates the need for refineries. The environment with methanol fuel will be unchanged with the recycling of CO_2 and H_2O combustion products. The production of ammonia by nuclear power fixation appears to be competitive with the traditional processes using natural gas and oil. Both the methanol and ammonia plants can be part of energy parks producing power, transportation fuels, fertilizer, as well as synthetic foodstuff, under clean environmental conditions, and at costs competitive with present-day polluting technology. (auth)

25480 (ERDA-52) LDC NUCLEAR POWER PROSPECTS, 1975--1990: COMMERCIAL, ECONOMIC, AND SECURITY IMPLICATIONS. (Barber (Richard J.) Associates, Inc., Washington, D.C. (USA)). 1975. Contract AT(49-1)-3665. 528p. Dep. NTIS $13.60.

The potential market for products of the U. S. nuclear industry in the lesser developed countries is evaluated. The political, economic, and security implications of U. S. nuclear technology exports to these countries are analyzed. Information is presented under the following headings: energy projections and economic change in less developed countries; comparative costs of nuclear and conventional power; the general policy environment and its effect on the nuclear power market potential; assessment of U. S. and foreign capabilities in the international competitive environment for production and sale of nuclear power plant products and services; and assessment of international and domestic implications of expanding exports of U. S. nuclear products to less developed countries. (DCC)

25481 (INIS-mf-1716, pp 189-194) THE NUCLEAR ENERGY INDUSTRIAL COMPLEX AND SYNTHETIC FUELS. Lewis, W. B. [nd].

From symposium on energy resources; Ottawa, Ontario, Canada (15 Oct 1973).

In symposium on energy resources, October 15-17, 1973. (Royal Society of Canada, Ottawa, Ontario).

It is proposed that a nuclear energy industrial complex should be on a sufficient scale such as 100 million kilowatts, in order to take advantage of economies of scale. Fluid, portable fuels play a very important part in the economy of North America, and at some point in the future the costs of conventional fossil fuels will rise to the point where nuclear energy can profitably be used to produce synthetic fuels. A table is presented showing the contribution of nuclear energy cost to the cost of synthetic fuels from carbon or limestone. (INIS)

25482 (INIS-mf-1716, pp 195-216) FISSION, FUSION AND FUEL ECONOMY. Mooradian, A. J. [nd].

From symposium on energy resources; Ottawa, Ontario, Canada (15 Oct 1973).

In symposium on energy resources, October 15-17, 1973. (Royal Society of Canada, Ottawa, Ontario).

An overview is given of the characteristics of light water reactors, gas cooled reactors, and heavy water reactors. The favorable fuel cycle characteristics of the Canadian PHW reactor are emphasized. Over the next 20 years there is predicted to be a doubling of nuclear capacity at time intervals shorter than 10 years. Cold cooling water shortages will force seashore siting. Plutonium fuel cycles will receive acute attention. Cost reduction or uranium enrichment will be very necessary and capacity must increase. Presently operating reactor concepts will continue to dominate the marketplace. Light water reactors will become less attractive as enrichment costs increase. High temperature gas-cooled reactors offer high thermal efficiency and the prospect of using ^{233}U. CANDU reactor variants already in operation offer advantages in thermal efficiency and fuel cycles using plutonium and thorium. Thermal reactors will breed ^{233}U from thorium and the LMFBR will breed plutonium from ^{238}U. In fusion, the state of the art is that scientific feasibility of a power-generating fusion device is yet to be demonstrated. (INIS)

25483 ECONOMICS OF NUCLEAR POWER. Bupp, I. C. (Harvard Univ., Cambridge, MA); Derian, J. C.; Donsimoni, M. P.; Treitel, R. Technol. Rev.; 77: 14-25(Feb 1975).

Present trends in nuclear reactor costs are interpreted as the economic result of a fundamental debate regarding the social acceptability of nuclear power. Rising capital costs for nuclear power plants are evaluated through statistical analysis of time-related factors, characteristics of licensing and construction costs, physical characteristics of reactors, and geographic and site-related factors. Conclusions are drawn regarding the impact of social acceptability on reactor costs, engineering estimates of future costs, and the possibility of increased potential relative competitiveness for coal-fueled plants. 7 references. (IAA)

Reactor Fuel Cycle Economics

25484 (NEDO-20841) BACK END OF THE FUEL CYCLE. Wolfe, B.; Lambert, R. W. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div.). 1975. 13p. General Electric Co., San Jose, California.

At present, that portion of the nuclear fuel cycle involving reprocessing, waste management, and mixed-oxide fuel fabrication is in an unsettled state. Government regulatory requirements with respect to all aspects of the back end of the fuel cycle are still being formulated, and there is little positive experience on the operation of commercial reprocessing or mixed-oxide fabrication plants. In view of this unsettled situation, it will be difficult to meet the reprocessing and mixed-oxide fabrication needs of the next decade in the pattern previously anticipated. The costs in the back end of the fuel cycle are much higher than had been anticipated several years ago, a situation similar to that of almost all large endeavors in this country. On the other hand, the added costs are small relative to total power costs and do not affect the economic advantage of nuclear power as compared to other power sources. A rough economic analysis indicates that the question for the back end of the fuel cycle has changed from one of optimizing profitability to one of determining the most economic disposition of spent fuel. Long-term spent fuel storage is a practical and economically acceptable way to provide time for determining a sound course of action for the back end of the fuel cycle. Indeed, if one could count on a breeder economy before the end of the century, one possible course of action is to store light-water fuel until the plutonium can be used in breeders. However, for philosophical as well as practical reasons, it is important that the uncertainties in the course of action should be resolved as quickly as possible. Long-term storage should not be an excuse to delay resolution of the basic questions. (auth)

25485 (ORNL-4988) INVENTORY CHARGE CALCULATIONS IN THE NUCLEAR FUEL CYCLE. Salmon, R. (Oak Ridge National Lab., Tenn. (USA)). Sep 1975. Contract W-7405-eng-26. 262p. Dep. NTIS $7.60.

Simplified methods are presented for the calculation of inventory charges or carrying charges on fuel, which represent the indirect component of the fuel cycle cost. These methods permit rapid calculation of the changes in fuel cycle cost caused by changes in the amount or timing of fuel cycle expenditures. The methods are developed by applying the discounted cash flow procedure to a single batch of fuel. In typical cases, this would be a batch representing equilibrium or steady-state reactor operation. The cost equations used are the same as those used in the computer code REFCO, described in ORNL-4695, which was based on the discounted cash flow procedure with continuous discounting. Equivalent procedures using the fixed charge rate concept also are developed. This is done in such a way that consistency with the discounted cash flow procedure is maintained. The fixed charge rate used here is defined in terms of tax rates and the interest rates on debt and equity capital. An effective inventory time is also defined. This is a function of the lead or lag time, the interest rates on capital, and the exposure time of the batch. Tabulated values of the effective inventory time and other useful functions, such as the ratio of indirect to direct cost, are included. Cost calculations using these tables agree with those produced by REFCO, the accuracy being within 0.001 mill/kWhr in the cases studied. (auth)

Reactor Licensing and Regulation

25486 (DOCKET-50213-429) HADDAM NECK PLANT. Semiannual Operating Report No. 75-1, January–June 1975. (Connecticut Yankee Atomic Power Co., Hartford (USA)). 28 Aug 1975. 134p. Dep. NTIS $9.75.

Net electrical power generated was 1,772,772.5 MW(e) with the generator on line 3315.17 hrs during this period. Information is presented concerning power generation, shutdowns, corrective maintenance, chemistry and radiochemistry, occupational personnel radiation exposure, release of radioactive materials, and abnormal occurrences. (FS)

25487 (DOCKET-50219-719) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Semiannual Operating Report, No. 12, January–June 1975. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 1975. 109p. Dep. NTIS $8.50.

The net electrical output was 1,544,941 MWH(e) with the generator on line 2,740.62 hrs during this period. The plant operated with an availability factor of 65.17 percent. Data is presented concerning power generation, shut downs, maintenance, chemistry and radiochemistry, occupational personnel radiation exposures, release of radioactive materials, and abnormal occurrences. (FS)

25488 (DOCKET-50282-401) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Semiannual Operating Report No. 4, January–June 1975. (Northern States Power Co., Minneapolis, Minn. (USA)). 29 Aug 1975. 70p. (DOCKET-50306-296). Dep. NTIS $6.50.

Net electrical energy generated by Unit 1 was 1,862,098(MWH) and the generator was on line 3,617 hours. Unit 2 generated 1,429,879(MWH) and was on line 3,358 hours. Data is presented concerning power generation, shutdowns, corrective maintenance, chemistry and radiochemistry, occupational personnel radiation exposures, release of radioactive materials, and abnormal occurrences. (FS)

25489 (DOCKET-50295-501) ZION NUCLEAR PLANT, UNITS 1 AND 2. Semiannual Operations Report, January–June 1975. (Commonwealth Edison Co., Chicago, Ill. (USA)). 11 Aug 1975. 95p. (DOCKET-50304-416). Dep. NTIS $7.75.

Unit 1 generated 1,869,892 MWH(e) net electrical and was on line 2,351.2 hours. Unit 2 generated 2,033,359 MWH(e) net electrical and was on line 2,677.8 hours. Data is presented concerning power generation, shutdowns, corrective maintenance, chemistry and radiochemistry, occupational personnel radiation exposures, release of radioactive materials, and abnormal occurrences. (FS)

25490 (DOCKET-STN-50535-23) GENERAL ATOMIC STANDARD SAFETY ANALYSIS REPORT, GASSAR-6. Report GA-A13200, Volume 1, Chapters 1-3. (General Atomic Co., San Diego, Calif. (USA)). 1975. 551p. Dep. NTIS $30.25.

The preliminary design of the NSS for the standard 3000 MW(t) [1160 MW(e)] high temperature gas-cooled reactor (HTGR) is presented. This design is applicable to sites of low to moderate seismic loading. The reactor operates on the uranium-235/thorium-232 cycle. Helium is used for the heat-transfer coolant and is circulated by circulators mounted above each steam generator. A prestressed concrete reactor vessel (PCRV) houses the reactor core, primary coolant system, and portions of the secondary coolant system. The secondary coolant is water. (FS)

25491 (FIND-STN-50502) FIND: KOSHKONONG NUCLEAR PLANT, UNITS 1 AND 2 AND WISCONSIN UTILITIES PROJECT, UNITS 3, 4, 5, AND 6. Hendricks, P. L. (ed.). (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Jul 1975. 49p. (FIND-STN-50507). Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

25492 (NRCI-75/6) NUCLEAR REGULATORY COMMISSION ISSUANCES, JUNE 1975. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Aug 1975. 202p. TIC $4.00.

Issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), and the Atomic Safety and Licensing Boards (LBP) are presented. (auth)

25493 (RDT-E-15-2NE-T(8-75)) CLASS MC NUCLEAR COMPONENTS (SUPPLEMENT TO ASME BOILER AND PRESSURE VESSEL CODE, SECTION III, SUBSECTIONS NA AND NE. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Aug 1975. 6p. RSO.

25494 LAW OF 9 JANUARY 1974 FOR THE ASSESSMENT OF ESTIMATES OF REVENUE FROM THE FUND FOR DEVELOPMENT OF A FAST BREEDER REACTOR FOR THE FISCAL YEAR 1974. (Ministerie van Economische Zaken, The Hague). Staatsbl. K. Ned.; 20: 1(Jan 1974). (In Dutch).

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Mathematics and Computers

Refer also to abstracts 24720, 25087, and 25140.

Miscellaneous

Physics and Engineering

25495 (ERA-75/2) ERDA REPORTS ABSTRACTS. Abstracts 101–250. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Apr 1975. 51p. TIC.

ERDA Reports Abstracts provides abstracting and indexing coverage of nonnuclear energy scientific and technical reports, patents, journal articles, conference papers, theses, and monographs originated by the U. S. Energy Research and Development Administration and its laboratories, energy centers, and contractors. It also covers reports from foreign governments with which ERDA has agreements for technical cooperation. Each issue of ERA contains subject, personal and corporate author, and report number indexes. The items in this issue are categorized as follows: coal and coal products, petroleum, oil shales and tar sands, hydrogen, other synthetic and natural fuels, solar energy, geothermal energy, wind energy, electric power engineering, energy storage, energy management and conservation, and energy conversion. (RWR)

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